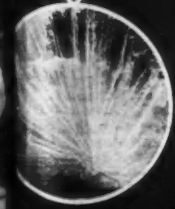
CHEMISTRY



MAY
1947

DDT and 2,4-D

➤ JUST A FEW years ago it could be argued that insects and weeds were necessary curses upon the human race.

And there was little significance or hope in this connection in the letters and numbers, D,T, 2 and 4, in any combination.

Today not one in ten thousand can tell you off-hand exactly what DDT and 2,4-D stand for, chemically.

Almost everyone has some idea, hazy though it may be, of what they can do.

Bug killers are not respectable without their adequate content of DDT.

Digging dandelions from the front lawn is an obsolete occupation since 2, 4-D can be bought at the florist shop or the hardware store. (This must have a bad effect on the dandelion wine home industry.)

There will still be insects in the world and all the weeds will not disappear from the garden. Some insects are good creatures and the definition of a weed is a plant that is not in the right place.

Chemical conquests, impressive as they are, will not be complete in these fields. Perhaps, it is just as well that this is so. Remember the dodo and protect the house fly from such a fate! What would the countryside be without a few misplaced plants. Or a garden that never needed a good, sharp hoe?

Yes, we remember. To save you the trouble of looking it up: DDT is dichloro-diphenyl trichlorethane.

2, 4-D is 2, 4 dichlorophenoxyacetic acid.

CHEMISTRY

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Including The Science Leaflet

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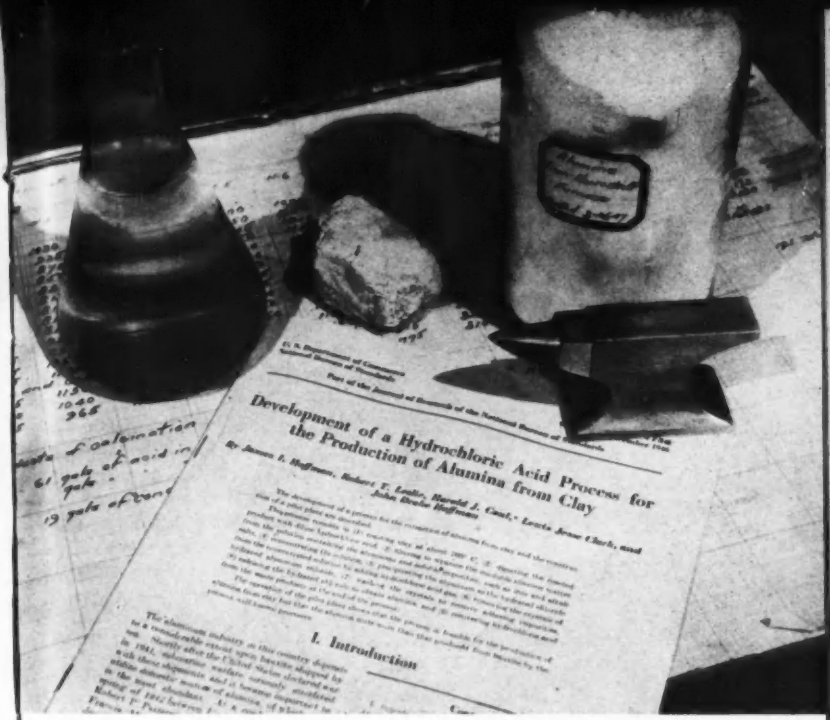


➤ TANGIBLE PROOF, *in the shape of a miniature anvil of pure aluminum, that light metal can be obtained pure from ordinary clay. Behind the anvil is a bottle of alumina,* Al_2O_3, *as it comes from the furnaces in the final stage of the Hoffman process, ready to go to the electrolytic refinery. The flask contains the concentrated hydrochloric solution from which aluminum is precipitated, leaving other elements in solution. Between them is a lump of silica which is gotten rid of at the beginning of the process, a step long believed impossible.*

Aluminum From Common Clay

by HELEN M. DAVIS

➤ THEY SAID it was impossible because it required too much energy. In addition, the Germans had tried it and failed. That clinched it. Nobody could extract aluminum from clay.

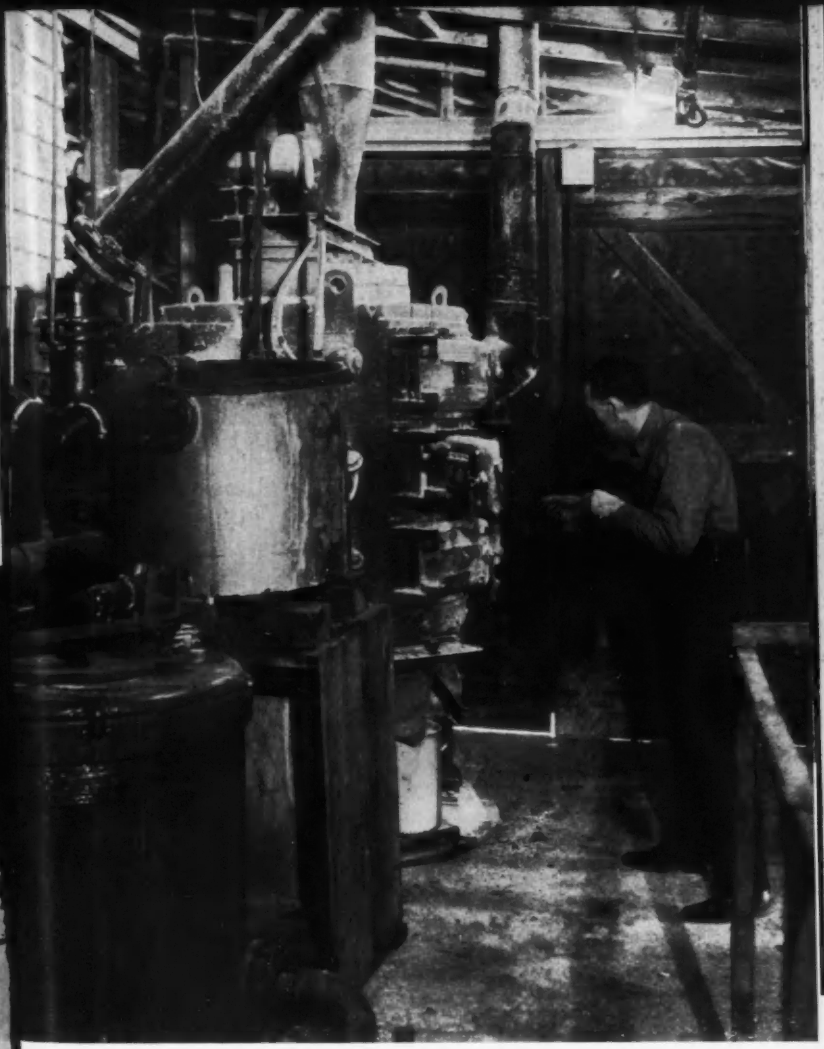
Everybody knew that untold quantities of the light, tough metal lies at our feet, locked up in that common-

est of minerals, hydrated aluminum silicate—common clay. Most chemists, following the dictum of some old-timers, were content to resign themselves to the idea that there it would remain forever.

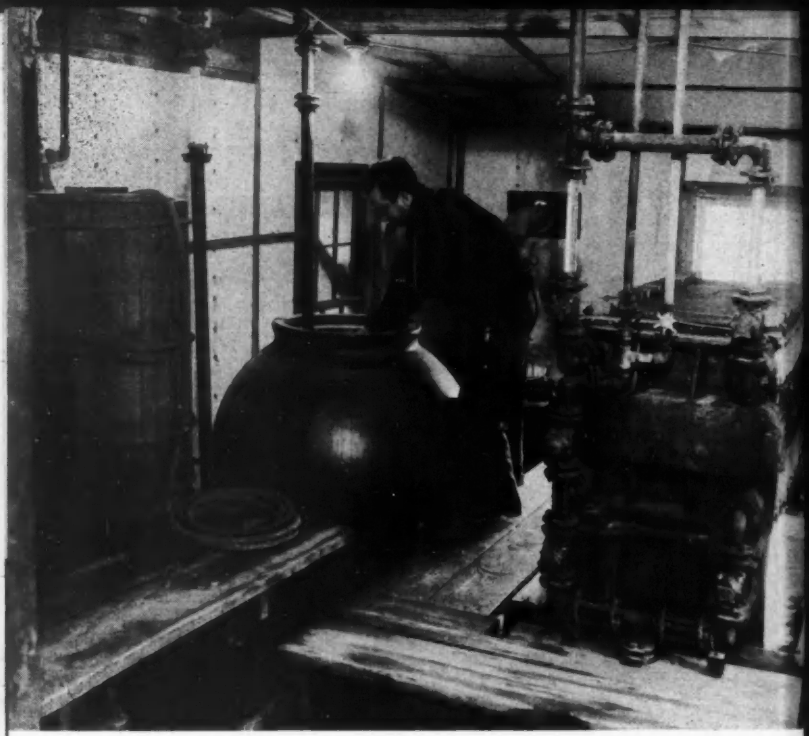
Not so Dr. James I. Hoffman of the National Bureau of Standards. When ships loaded with bauxite, the sole practical ore of aluminum, were regularly setting out from foreign ports during the war, only to end their voyages in the depths of the sea, the War Department called upon the government scientist to "do something."

Dr. Hoffman, trained as an analytical chemist, is accustomed to pursuing elusive metals through cycles of alternate solution and precipitation. He knows how aluminum salts behave in test tubes. "Why not," he asked, "use these laboratory methods on a pilot scale and take out the aluminum in a form in which we can feed it into the commercial re-

➤ CLAY REJECTED *as too coarse by the manufacturers of dishes is the raw material of the Bureau of Standards pilot plant. It is white to yellow in color, but even the red clays of the southern states can be used in the Hoffman process, in which aluminum is precipitated and other metals are left in solution. All photos by Fremont Davis, Science Service photographer.*



▶ PRELIMINARY HEATING *loosens the bond between alumina and silica in the clay, so that the metal later goes into solution as aluminum chloride. Herbert Lowey watches the charge in the furnace he adapted for this purpose.*



➤ SILICA *is filtered from the solution of aluminum chloride after the roasted clay is dissolved in HCl. Alkaline processes for extracting aluminum from clay do not effect complete separation of silica, and the resulting metal is alloyed with a considerable quantity of the non-metallic element. Getting rid of silica early in the process is the unique feature of Dr. Hoffman's method.*

duction process and get the metal?"

There were plenty of experts who dogged Dr. Hoffman's footsteps whining that it could not be done, but with the help of a small but devoted crew of fellow-workers a pilot plant was rigged up. They built it in an abandoned garage, which was once a stable. Their three-story Herreshoff furnace, where, as the final stage in the process, the precipitated chloride is ignited to change it into the oxide, alumina, rises from the floor of the one-time stalls to the gable-peak of the hayloft.

The group assembled rather than built the equipment. A replaced and obsolescent boiler from the Bureau's power plant was a lucky find. Bit by bit, under the skillful hands of Herbert Lowey, their instrument maker, the plant took shape. With Dr. Hoff-

▶ AFTER BEING *boiled down, the hydrochloric acid solution from the filter press is pumped up to the tank shown in the background. From here it trickles down while a column of gaseous HCl bubbles up through it. This precipitates pure aluminum chloride, leaving iron and other metals in solution. Dr. Robert T. Leslie is reading the temperature, which is increased by this reaction. Vats and pipes are made of plastics impervious to acid. Frequent glass sections allow the process to be watched.*

man worked Dr. Robert T. Leslie, George Derbyshire, Willard Hubbard, Wilmer A. Hemminger and Lewis J. Clark, aided also by Dr. Hoffman's son, John Drake Hoffman, who has now returned to finish his work at Princeton. During part of the time H. J. Caul, on loan from the American Dental Association, also worked with the group.

For raw material these scientists can use almost any kind of clay, but the kind they are working on at present is rejected as too coarse by

the factories that make fine china dishes. It is white to pale yellow in color, the yellowish tints betraying the presence of iron.

Iron was a stumbling block to one of the suggested methods for solving the aluminum from clay problem. In that method the materials not wanted were removed, and it would take a lot of removing to get rid of all the iron in the red clays of our southern seaboard states.

While Dr. Hoffman prefers the white clay to the red for his pilot plant, the presence of iron does not trouble him. In his process the aluminum compound, which he does want, is taken out of solution, and the rest of the material runs off in the liquid squeezed out of the filter.

The reason chemists for over a century have been saying that aluminum from clay is an impossibility is the fact that the light metal is there found combined with silicon and oxygen in a form which requires energy to break up. The amount of energy required was believed to be so great that it would never be possible to sell the finished metal for enough money to pay for its manufacture.

Several other processes for obtaining the light metal from sources other than bauxite have been tried out on an experimental scale. Three of them use sulphuric acid or a sulphate mineral, whereas Dr. Hoffman's is the only process using all hydrochloric acid. The other type method employs the chemically opposite alkaline reaction, known in general as the Bayer process.

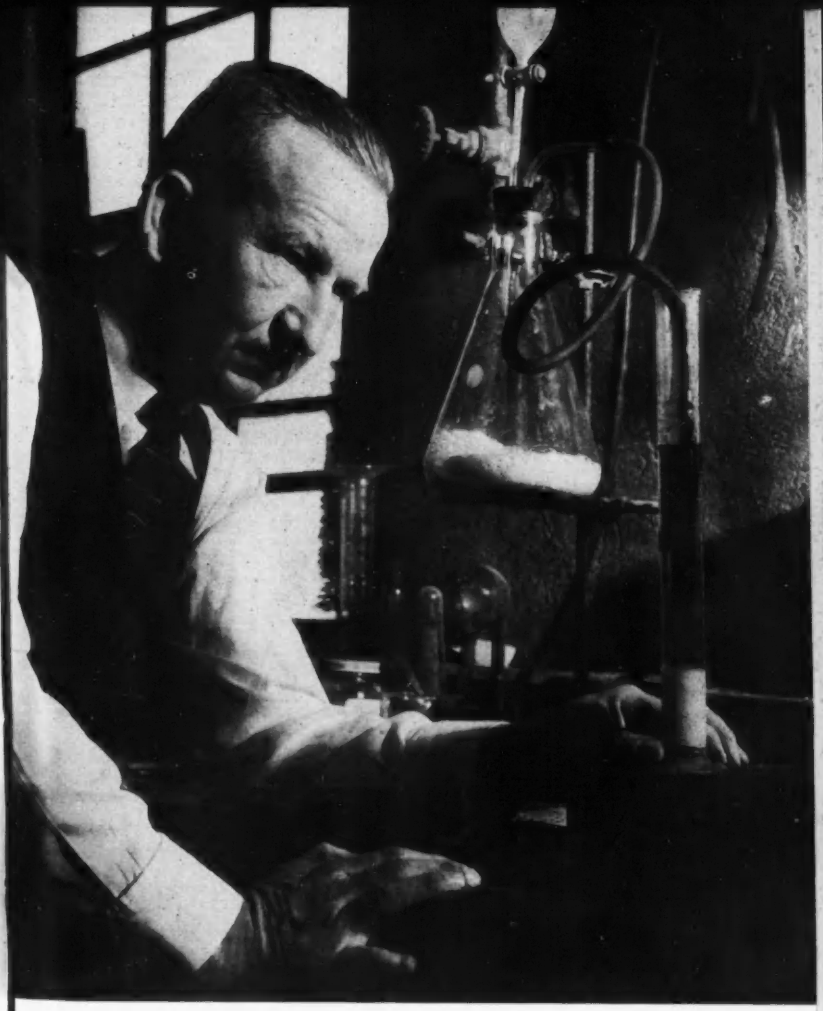
Variants of this alkaline process use lime or lime-soda, with which the clay is roasted until it glows, or sinters. Water soluble aluminum salts are then leached out by washing. Such processes have been worked out by Dr. Connolly and associates at the U. S. Bureau of Mines, by Dr. Wells at the Bureau of Standards, by Monolith Portland Cement Co. in Wyoming, by the Ancor Corporation at St. George, S. C., and probably by Alcoa.

Economically, these processes depend upon the lucky occurrence of lime and clay of the proper quality in neighboring locations. The Anaconda Copper Co. put a process through the pilot plant stage in which they started with hydrochloric acid but ended with the Bayer method.

Of the sulfuric acid processes, one was worked out by TVA at Wilson Dam, Ala. A modification of this method, known as the Kalunite process, has been worked out for getting aluminum from the sulfate mineral, alunite. A third kind of similar process using ammonium sulfate was developed by the Chemical Construction Co. in the Pacific Northwest.

Naturally, the men who worked out these processes are each proud of success in doing what "could not be done." None of these experimental processes can at present compete economically with the standard bauxite method. But "the availability of all the foregoing processes," according to Dr. Hoffman, "affords good insurance for an abundant supply of aluminum in the United States in the future."

The all-hydrochloric acid process which Dr. Hoffman has demonstrated



➤ Dr. James I. Hoffman, *chemist of the National Bureau of Standards, who has succeeded in adapting a laboratory method to large-scale operation to get pure alumina from clay. Here he demonstrates with laboratory apparatus how gaseous hydrochloric acid throws aluminum chloride down from the acid solution in his process.*

▶ FINENESS *of the alumina obtained after final ignition, which changes aluminum chloride to the oxide, is demonstrated by George Derbyshire. After adjusting for the finer grain, alumina from the Hoffman process is found to be better for electrolytic reduction than bauxite itself.*

has the advantage of producing pure alumnia, ready for eletrolytic reduction. It gets rid, in its first step, of the silica half of the clay. This is the step long believed theoretically impossible. Many metallurgists had resigned themselves to the idea that silica-free alumnina from clay could never be a paying proposition.

But Dr. Hoffman and his associates have found conditions otherwise. They first heat the clay to about 1300 degrees Fahrenheit which, as industrial processes go, is a rather mild temperature. This is not hot enough to bake the clay into refractory brick, but it furnishes enough energy to break the connection between the aluminum and the silicon in the molecule. The silicon then comes out as so much inert white sand, or silica, which takes no further part in the chemical process.

After the first roasting, the clay is dissolved in a solution of hydrochloric acid and filtered off from the silica. From this point the object is to get out of the solution only a compound of the aluminum, which is desired, and to leave everything else in solution.

It is here that Dr. Hoffman's special knowledge of the behavior of aluminum compounds stood him in good stead. He knew that if more hydrochloric acid, in the form of a gas, is led into a concentrated solution such as he gets by boiling down the liquid that comes from his filter, the aluminum and nothing else in it will turn into a fine white powder and collect at the bottom of his tank. And as a special bonus, the chemical action gives out heat, which helps on the fuel bill.

Here, again, the wiseacres said, "It can't be done. The crystals, that fall through the liquid trickling down your precipitation column while the acid gas bubbles up through it, will cut your pumps to pieces."

But Dr. Hoffman knew he had a fantastic corrosion problem to face when he started out. He presumed that it was the impossibility of preventing hydrochloric acid from eating away their metal tanks that had made the Germans give up the process years before. But with modern materials available, Dr. Hoffman built his plant with plastics and glass in place of metal, and defied the abrasion of the crystals and the acid vapors. Besides, he can watch the liquids circulating through the glass pipe sections and see how the process is coming on.

The vapors take their revenge on the scientists by destroying their clothes. Anything made of cotton soon falls into shreds in the experimental plant, so that even the window cords have either to be replaced by gaudy-colored decorators' cords of synthetic material or abandoned in favor of old-fashioned props.

Coming to work, the scientists hang their street clothes on glamorous plastic hangers designed for evening gowns but impervious to acid. They shut the garments away behind heavy wooden doors, and put on tattered old clothes which can stand the gaff.

Dressed like beggars, these keen-eyed men figure on economies that will run into millions of dollars when their process is put into full commer-

cial operation, even though, as a government development, their pioneer work is available to any manufacturer with the foresight to take advantage of it.

The cost problems now being studied are the usual ones of chemical production, economical use of power and recovery of usable materials from waste. At present the price of metal recovered by the Hoffman process is about twice that from bauxite brought from abroad.

Many factors may operate to change that cost ratio in the future. What the Bureau of Standards scientists have done is to work out in practical terms the answer to an old laboratory problem. They have proved that commerical extraction of aluminum can be done.

Now these chemists are going on to details of economical operation of the plant, and by-product recovery. They are confining and reusing the acid vapors. They point out that many of the elements that occur in the clay are all in solution in the filter water, if anyone can use them. Iron is there certainly, although it would not pay to take it out. Other valuable materials, such as potash, may be present in some clays.

It might pay to recover some of them, although, says Dr. Hoffman, "this hardly likely to be the case in the first 190 billion tons of clay that we will use." One hundred ninety billion tons of clay will yield nearly 38 billion tons of aluminum metal by the Hoffman process. Aluminum, being one of the lightest as well as most abundant metals, gives us more sheet metal to the ton than any other common structural material.

New Uses for Fatty Acids

➤ Fats, though at present in short supply, are likely to pile up into surpluses in normal times, and therefore challenge industrial chemists to find new and profitable use for them, Dr. Anderson W. Ralston, chief research chemist of Armour and Company, told an audience of his colleagues after he had been presented with the Midwest Award of the American Chemical Society at St. Louis recently.

Until relatively recent times, about the only non-dietetic use for fats was in the production of soap and glycerin. Since glycerin constitutes only about a tenth of the total mass of fat and fatty acids the other nine-tenths, the big problem is to find some use for fatty acids other than in soap.

One new way of making fatty acids useful is to combine them, at high temperature, with ammonia, which results in the formation of a group of compounds called nitriles. These have many economic applications.

Some of these compounds, especially lauronitrile, while odorless to human beings, seem to smell very bad to insects. Hence they can be used effectively in insect repellents.

Nitriles are also used as plasticizers for a variety of polymers, and their derivatives find wide uses as promoters of reactions in numerous industrial processes. Salts of amines derived from nitriles can be used in waterproofing building materials, and in flotation processes for minerals.

New Knowledge Gained Through Radioactive Isotope Study

Tagged Atom Discoveries

Scientists have reported at a number of recent meetings new understanding of life processes which can now be followed step by step. By replacing ordinary atoms with isotopes whose extraordinary weight or whose radioactivity allow them to be spotted in the course of their journeys through life processes, scientists are learning how many of these complex reactions come about. Some of the latest developments in this rapidly unfolding field of chemistry are brought together here.

Protein Synthesis Outside Body

➤ THE FIRST DIRECT observation of protein synthesis outside the animal body has been achieved through the tools of atomic science.

Two University of California scientists reported this pioneering step in the application of radioactive substances to the study of growth, cancer and other biological processes associated with the building up of organic compounds in living systems.

Surprisingly, the advance was made with radioactive sulfur, which has been available to researchers on the Berkeley campus for a number of years. The technique of study will have its widest application with radioactive carbon 14, which was only recently released to scientists by the Manhattan District.

The two researchers, Drs. Harold Tarver and Jacklyn Melchior, placed living animal tissue slices in a solution together with methionine labeled with radioactive sulfur. Methionine is one of about 25 amino acids, which are sometimes called the building blocks of all life.

The liver slices were slowly dying, with a breaking down of protein into amino acids. But so long as they lived they were building up some new protein, using the discarded amino acids. This process was demonstrated by the finding of labeled methionine incorporated into the protein of the tissue slices.

Proteins are formed by the linking together in chains of various amino acids. Drs. Tarver and Melchior found that the radio-active methionine was incorporated into the protein by the formation of peptide bonds, which are the typical linkage between the amino acid molecules in all proteins. In this linkage a carbon atom of one molecule is linked to the nitrogen atom of another molecule.

The scientists succeeded in their experiments after failure to demonstrate true protein synthesis using radioactive cysteine, another sulfur-bearing amino acid.

Dr. Tarver expressed the opinion that the study, applied with radioactive carbon, provides an unexcelled technique for the study of the formation of the all-important peptide bond. For the first time biochemists

are able to come to direct grips with the problem of protein synthesis.

The technique will also enable Dr. Tarver and other scientists to study the differences between protein formation in different tissues, for example between normal and cancer tissue.

Its use with sulfur will be limited, since only methionine and cysteine, of the amino acids, contain sulfur. However, all the amino acids have carbon atoms.

"Life" Elements Tagged

➤ CARBON 14, hydrogen 3, sulfur 35 and phosphorus 32 are the artificially radioactive elements likely to be most useful and most used as tracers in research, Dr. G. E. Boyd of the Clinton Laboratories, Oak Ridge, Tenn., told the meeting of the American Chemical Society at Atlantic City. It happens that these are four of the six elements invariably found in protoplasm, or living matter, the other two being nitrogen and oxygen. These four elements are also the foundation-blocks of a vast variety of organic compounds that are not alive, ranging all the way from lubricating oils to cleaning fluids. Along with these, another group consisting of radioactive bromine, chlorine, iodine and fluorine is also expected to be very useful.

Iron, Iodine and Blood

➤ NEW KNOWLEDGE about the circulation of the blood and treatment of shock has been gained by the use of radioactive iron and iodine. Without the use of radioactive isotopes, such as are made in the atom bomb uranium pile, this new knowledge could not have been gained, Dr. John G. Gibson, 2nd, of Harvard Medical School, declared at a conference on isotopes in Nashville recently. The conference, held at Vanderbilt University in cooperation with the Clinton Laboratories and the Oak Ridge Institute of Nuclear Studies, was devoted chiefly to use of radioactive chemicals as tracers and in treatment of patients.

Treatment of shock should be devoted not only to restoring the total volume of blood in the body, Dr. Gibson's studies show. It should also be directed toward starting the blood flowing again in the tiny blood vessels called capillaries and keeping it circulating in these vessels.

In a state of shock, the amount of red blood cells and plasma circulating in the veins and arteries is always reduced below the amount that can be accounted for on the basis of the amount of blood lost through bleeding from a wound. Some of the unaccounted for blood may be lost into the damaged part of the body, instead of out of the body, or by bleeding from the intestines in certain types of shock.

Regardless of cause, Dr. Gibson has found that in shock red blood cells get "trapped" in the tiny blood vessels in all the organs of the body. This trapping is widespread. As a result, the amount of blood flowing in capillary blood vessels through all the organs is reduced. The normal

amount of blood in these capillaries is less than a fifth of the total volume of blood in the body. So the trapping of even a small part of it may fatally reduce the flow of blood through the capillaries.

Red blood cells tagged with two kinds of radioactive iron and blood serum albumin tagged with radioactive iodine were used in the studies. Before this radioactive isotope method became available, blood circulation was studied by the use of a blue dye and by measuring the mass of red cells that collect at the bottom of a glass tube when a sample of blood is whirled around in a centrifuge. Discrepancies between the results from these measurements in humans who had hemorrhages showed that the results obtained did not give a correct picture of the blood circulation. The isotope technique is free from the errors of the other methods.

Cancer and Gold

➤ CANCER AND LEUKEMIA patients are now being treated with radioactive gold from the chain-reacting uranium pile that created the atom bomb.

"Results in chronic cases (of leukemia) have been equally good if not better than results obtained with X-rays," Dr. Paul F. Hahn, associate professor of biochemistry at Vanderbilt School of Medicine, declared at the isotope conference.

A total of 33 leukemia patients and 30 miscellaneous tumors have been treated so far. Favorable results have been obtained in leukemia of the chronic variety only.

Two leading advantages of the treatment over X-rays, Dr. Hahn said, are the lack of radiation sickness and the simplicity with which the radioactive material is given.

In leukemia, the radioactive gold is injected into the patient's vein. In the case of a tumor or cancer it is injected into the tissues so as to infiltrate the tumor with the radioactive material. Time in hospital and expense are saved. The treatment can be given in a few minutes and the patient can then go back home or to work if necessary.

It costs only about $5 for enough radioactive gold to produce a "satisfactory remission," or temporary improvement such as X-rays give, in certain types of chronic leukemia.

When the radioactive colloidal gold is infiltrated into tumors, it remains fixed at the site where it was deposited. The tumor is then constantly bombarded with rays from the radioactive gold, something as is the case when a radium needle is deposited in or near the tumor for a time. The use of radioactive gold, however, eliminates many of the undesirable features accompanying the use of radium under similar circumstances, Dr. Hahn said.

Dr. Hahn and his assistant, Dr. C. W. Sheppard, have been conducting a cancer and leukemia treatment program for the past 20 months. At first they used radioactive colloidal manganese made in the cyclotron. This had the disadvantage of a relatively high cost. When material from the uranium pile became available, they shifted to use of radioactive colloidal gold. This decreased the cost of treatment to about two per cent of the former cost.

Vanderbilt University's nearness to the uranium pile at Oak Ridge makes it a logical center for work of this kind, Dr. Hahn pointed out. At present Vanderbilt is receiving more radioactive material from Oak Ridge than any other medical school in the United States.

Heavy Oxygen Settles Disputes

➤ A KIND OF heavy oxygen, with an atomic weight of 18 instead of the usual 16, can now be used to settle long-disputed points in chemistry and physiology, Dean Hugh S. Taylor of Princeton University told chemists at their recent meeting. The isotope-separation techniques developed by the Manhattan District make this type of oxygen available for research purposes in any reasonable quantity if the cost can be met.

As an example of the long-standing problem already solved with molecules "tagged" with heavy oxygen, Dean Taylor mentioned the fates of water and carbon dioxide taken in by plants. Both compounds contain oxygen, the sum of which is in excess of the plant's needs for its food- and body-building processes. Plants have long been known to give off oxygen: where did it come from? By the use of "tagged" molecules of water and carbon dioxide it has now been demonstrated that the oxygen going in with the carbon dioxide stays in as part of the plant structure, whereas the oxygen that goes in as part of water comes out again as pure oxygen.

Radioactive Million Years

➤ CHLORINE, one of the elements in common salt, can be made radioactive by exposure to neutrons in the atomic pile so that one radioactive form of it will keep on giving off radiation for more than a million years. Dr. Ralph T. Overman, of the Monsanto-operated Clinton Laboratories at Oak Ridge, Tenn., reported on four activities produced by long neutron irradiations of various chlorine compounds in the Clinton Laboratories chain-reacting pile.

Since Bikini bombs bombarded the salty sea water with neutrons, this means that some of the radioactive chlorine produced has a half-life of a million years and the effects of the Bikini bombings will be felt in this way for longer than a million years.

Scientific Wonderland

➤ WITH THE TOOLS of atomic science America has created a scientific wonderland, a dream come true of scientists a quarter-century ago.

This is an observation of Prof. Georg Hevesy, Scandinavian Nobel Laureate who 30 years ago performed the first "tracer" experiments. In these pioneering experiments Prof. Hevesy used bismuth and lead, two elements which are slightly radioactice in their natural state, tracing their course in chemical reactions.

Prof. Hevesy recently visited the Radiation Laboratory of the University of California, where he studied the latest developments in biological research with the artificially radioactive substances used in "tracer" studies.

"This is a utopia of science," Prof. Hevesy stated. "In the old days we often dreamed of the time when we might have such radioactive tools as

are now commonplace in your laboratories.

"Even though this new science is in its infancy, it has already deepened our knowledge of so many biological processes. In the future we can expect that tracers will be used almost as routinely as the microscope."

In tracer studies radioactive substances which are eaten by animals and man or absorbed by plants are followed through their course in living systems by means of the radiations emitted.

Prof. Hevesy's last visit to the United States was in 1931, at which time he was shown the model of Prof. Ernest O. Lawrence's first cyclotron. He remarked that the developments since that time have been "phenomenal."

Prof. Hevesy recalled that much of his tracer research after 1934 and until the beginning of the war was made possible by shipments to Copenhagen of radioactive phosphorus, sodium and potassium produced by the Berkeley cyclotrons.

The Scandinavian scientist said he hopes in the near future to be able to obtain radioactive carbon and other substances produced in relative quantity in the Oak Ridge, Tenn., atomic ovens. At the present time these substances are not available to foreign nations.

Government Atomic Laboratory

➤ Brookhaven National Laboratory for atomic research is now under construction on the 6,000-acre site of Camp Upton at Brookhaven, L. I., and will be ready for the 100 scientists expected later this year.

It is a government-owned, government-financed undertaking, operated by Associated Universities, Inc., under contract with the United States Atomic Energy Commission. Associated Universities is an organization of nine major Eastern universities. Representatives of these institutions constitute the board of trustees which is erecting the plant and will direct the laboratory's activities.

The plan is to make this project a center of atomic research and training, particularly to find peacetime applications of atomic energy. The laboratory will provide facilities for research to universities, industrial organizations and other research groups under a permanent scientific staff, and it will be equipped with apparatus which individual institutions would be unable to obtain.

Some of its scientific activities are already under way, particularly the design of an atomic pile and other large equipment. Plans call for the construction of a graphite uranium pile, and what will be known as a "hot" laboratory where radioactive isotopes may be separated. A second pile is planned; it will have 100 times the neutron flux of the first.

A 30- to 40-million electron volt cyclotron is to be obtained; also an electro-nuclear machine capable of accelerating either electrons or positive particles to energies of a billion volts. A 20,000,000-volt electrostatic generator is another piece of equipment of the heavy type.

The laboratory expects to concentrate on fundamental research. This will include work in the physical, chemical, biological, medical and en-

gineering aspects of atomic science. With a permanent scientific staff of 300, and a visiting staff from cooperating universities of 200, it will become a great training center for young scientists, it is expected, as well as a research institution.

Atom-Smashing Doughnut . . .

➤ AN ATOM-SMASHING "doughnut" is being shipped from Schenectady to the famous Clinton Laboratories at Oak Ridge, Tenn.

The 74-inch "doughnut" is the heart of a 100,000,000 electron-volt betatron. Shipment of the parts of the new atom smasher has begun, but the final components will not be shipped until midsummer.

Dr. G. W. Dunlap, who is supervising work on the beatron at the General Electric Company's General Engineering and Consulting Laboratory, explains that the electron accelerator, or atom-smasher, can be compared with an ordinary transformer. Main difference is the "dough-nut," a hollow doughnut-shaped vacuum tube which replaces the metallic secondary conductor of the transformer.

The betatron produces X-rays as much as 50 times as intense as those produced by an ordinary X-ray machine.

Uranium Fission

➤ WHEN URANIUM, the atomic bomb element, fissions it can give birth to triplets and quadruplets as well as the conventional twins of hearts of other lighter elements.

This discovery, announced in the Physical Review, was made by two Chinese and two French scientists working in Paris at the nuclear chemistry laboratory of the College of France.

When a uranium atom splits into three, instead of the usual two atomic fragments, more atomic energy is actually released.

Since the ternary fission occurs only about once while 300 or more ordinary fissions are happening, this increase of energy is not very important.

Still rarer are the cases of quantenary fission in which four fragments are produced.

The new fission processes were discovered by use of photographic plates soaked in a uranium compound and exposed to slow neutrons.

The scientists who did the experiments are Tsien San-Tsiang, Ho Zah-Wei, R. Chastel and L. Vigneron.

When uranium and plutonium fission they give off relatively long-range helium atoms, called alpha particles, flying through eight inches of air. This was discovered at the Los Alamos bomb laboratory in 1944 and only now released from wartime secrecy. When observed by Dr. G. Farwell, E. Serge and C. Wiegand it seemingly was not too important in building the bomb and the investigation of this effect is only now being continued.

Elements From Atom Bomb

➤ JUST WHAT HAPPENS when an atomic bomb fissions and what chemical elements are formed in the big smashup of uranium 235 atoms is now known.

The American Chemical Society was told by Dr. Aristid V. Grosse, now of the Houdry Process Corp.,

that 34 different elements have been detected among the fission products of the kind of uranium that can be made into a bomb.

Four elements, neodymium, barium, zirconium and molybdenum, account for nearly half of the weight of the uranium split asunder with great release of atomic energy. More than 10% of the weight reappears after the fission in each of these elements.

Two elements that do not occur naturally, because they are radioactive and thus destroy themselves, are produced in substantial amounts in uranium fission. These are element 43, recently named technetium, and element 61, as yet unnamed.

For each hundred pounds of uranium 235 fissioned, 2.6 pounds of technetium and 4 pounds of element 61 are produced.

This means that at Bikini, where two bombs were exploded, several pounds of each of these hitherto nonexistent elements were manufactured and let loose in the world.

The chemists determined the amounts of elements formed by measuring the results of controlled fission or production of atomic energy in the large structure, called an atomic pile, in which slowly moving neutrons (electrically neutral atomic particles) cause the splitting of the uranium atoms in a controlled manner. The results should, however, apply in essential features to fast neutron fission such as occurs in the atomic bomb, whether it is made of uranium or plutonium.

Element 61 Christening Delayed

➤ CHRISTENING of element 61 was expected to take place at Atlantic City, but has been delayed probably until the fall meeting of the American Chemical Society. The discoverers of the element, who worked together on the Manhattan atomic project, are not yet ready to decide on the name since some of the information they wished to announce at the same time is still being kept secret.

Liming Reduces Fluorine

➤ DAMAGE TO CROPS from fluorine, a farming hazard that has arisen since the large-scale introduction of this poisonous element into certain industries during the war, can be materially reduced by heavily liming the soil, experiments at the New Jersey Agricultural Experiment station at New Brunswick show.

In the tests, buckwheat and tomato plants were grown in pots of soil to which various amounts of fluorine had been added. Fluorine damage to plants in soil lots that had also been well limed was much less than it was in unlimed, acid soils. On this basis, the scientists recommend application of lime and superphosphate to soils where industrial pollution with fluorine is a factor.

Nylon rope, used to pick up and tow gliders behind airplanes, can stretch nearly a third without breaking.

On the Back Cover

➤ RADIOACTIVE TRACER *atoms are being used to chart accurately the course of one of the new plant-killing chemicals known as INBA, from the spot where a very small quantity of it is placed on a bean leaf, down the stem and throughout the rest of the plant. The work is being done by Drs. John W. Wood, J. W. Mitchell and George W. Irving, Jr., at the U. S. Department of Agriculture's experiment station at Beltsville, Md.*

INBA, which spells out in full as 2-iodo-3-nitrobenzoic acid, belongs to the same chemical family as the now familiar 2,4D. It is being used in the present experiment partly because of the readiness with which radioactive iodine can be built into its molecules, making it a tracer compound of high power.

Spread of the poison throughout the plant can be traced in either of two ways: a Geiger counter can be applied to various parts of the plant body and the "ticks" counted, or the plant can be cut off, pressed flat in contact with a photographic film and left for a suitable exposure period, after which the radioactive spots and lines will be found accurately registered on the negatives.

The INBA does not spread to any great extent through the leaf to which it has been applied. Instead, it travels with the food formed in that leaf down to the main stem, then up that to its apex, down it into the roots, and up into the other leaves. Both methods of recording its presence show a special tendency for the chemical to concentrate in still-unopened leaf-buds, which accounts for the effectiveness of plant-killers of this type in crippling their victims through prevention of further growth.

Experimental plants used in the experiments thus far have been principally beans and barley. Beans are easily poisoned, but barley, being a member of the grass family, proves resistant.

Isotope Prices Change

➤ THE ATOMIC ENERGY Commission has revised its price list for the radioisotopes which it sells for scientific research. Some of the isotopes have dropped sharply in price while others are up, under a new system which charges on the basis of space occupied by the material instead of neutrons absorbed by the material.

The important radioisotope carbon 14 has been reduced from $367 per millicurie, the unit of measurement used in the sales, to $50. Phosphorus 32 and iodine 131, other frequently used isotopes, remain the same price.

Under the new charges, radiogold goes up from $7.36 to $12, while the more expensive radiosilver drops from $121.30 to $33.

Reporting that 466 orders for the radioactive byproducts have been processed, the Commission said it is charging only a portion of the actual operational and overhead costs. The tiny research tools are produced at the uranium chain-reacting pile of the Clinton Laboratories, Oak Ridge, Tenn.

Aim to Increase 50% Over Pre-War Level by 1950

U. S. S. R. Chemical Production

➤ The Soviet chemical industry has embarked upon a vast expansion program designed to boost production by 1950 to 50 per cent above the prewar level.

Huge chemical plant developments in eastern Russia and Siberia and a tremendous increase in output of fertilizer and heavy chemicals are outstanding features of Russia's new Five-Year Plan.

An annual production of 900,000 tons of synthetic fuel oil is projected, despite Russia's position as the world's second largest petroleum producer, according to W. G. Cass, for the American Chemical Society's Chemical and Engineering News. Oil fields suffered great damage in the war and new fields, such as those in the Volga-Ural area, have not come up to expectations.

Synthetic rubber production is to be doubled, constituting an estimated 38 per cent of the world total, and output of artificial fibers, especially rayon, will reach a figure four or five times the prewar average.

Several new branches of organic chemistry, based partly on coal and petroleum, are to be developed, as well as synthetic tars, plastics and alcohol, it is reported.

Superphosphates for use in fertilizers figure largely in the Five-Year Plan. In Russia probably more than in most countries a substantial proportion of the chemical industry is dependent on agricultural output in the widest chemurgical sense, and conversely agriculture looks to the chemical industry to supply all the chemical fertilizers, insecticides and other similar products needed.

"What are called the hydrolytic industries, based on forest product utilization, will be largely extended—that is to say, the manufacture of ethyl alcohol, acetone and that group, sulfite derivatives, rosin, and turpentine," the report continues. "But in the field of oils and fats little is said, despite Russia's former enormous production of sunflower seed oil, much of which was fat-hardened and used for margarine and soap. Output of this last should be 870,000 tons in 1950, as against 495,200 tons in 1937 and 400,000 tons in 1940. So far as possible substitutes for natural fats will be used in soap-making, such as synthetic fatty acids and soap-naphtha, in order to have the maximum fats available for food."

The whole Russian chemical industry is now under the control of a Ministry of Chemistry, the present minister being Michael Pervoukhin. Among the many natural resources to be intensively exploited are the potassium and magnesium salts in the central and southern Urals; the sulfur deposits—some 45 meters thick—in Kara-Tau; the rich coal beds of Kouznetsk in Siberia, which will constitute the industrial center of that vast territory, and natural gas in the Saratov region and elsewhere.

Controlling Vapors

If you have made a piece of laboratory equipment that you would like to tell fellow-workers about, send in a short description to the Hints Editor, 1719 N St. N.W., Washington 6, D. C.

➤ One of the problems faced by all chemists is the elimination of chemical vapors and gases from their laboratories. In many cases these gases are not only unpleasant, but are noxious as well and must be removed effectively.

The simplest way to do this of course, is by use of a ventilated hood; but most amateur chemists do not have such facilities. Here are two devices for disposing of gases that have proved very useful in the home laboratory.

Drawing on the opposite page shows, at the left, an effective hood which proves to be versatile. This is for use above open beakers, evaporating dishes, and like apparatus from which fumes are being evolved. The gentle suction of the fan draws the fumes into the hood and through a layer of chemical absorption agent and a layer of activated charcoal. The chemical agent should be chosen for the specific absorption job that is to be done. Soda lime will be effective against acid fumes and many other gaseous products, so it can usually be used in filling the tray. The tray is built in the form of a sliding drawer, in order that it can be removed without disassembling the entire apparatus and the hood recharged with a minimum of labor.

The hood dimensions can be left to the discretion of the individual, since the size of the fan will determine the approximate size of the hood. My apparatus was built using both sheet metal and wood. These two materials will probably be popular choices, but naturally the materials of construction need not conform to any special plan.

The columns at the right show methods of scrubbing waste gases as they pass out of the reaction apparatus. For the most part these are self explanatory and construction is quite simple. I made use of discarded fluorescent tubes from which to fashion the cylindrical towers. These scrubbing towers prove to be efficient not only in removing waste gases, but also for general absorption of other useful product gases.

Aloys L. Tappel

A—Electric motor mounted using corner braces.

B—Wire support allows hood to be moved and placed above working space.

C—6-volt automobile fan with blades reversed.

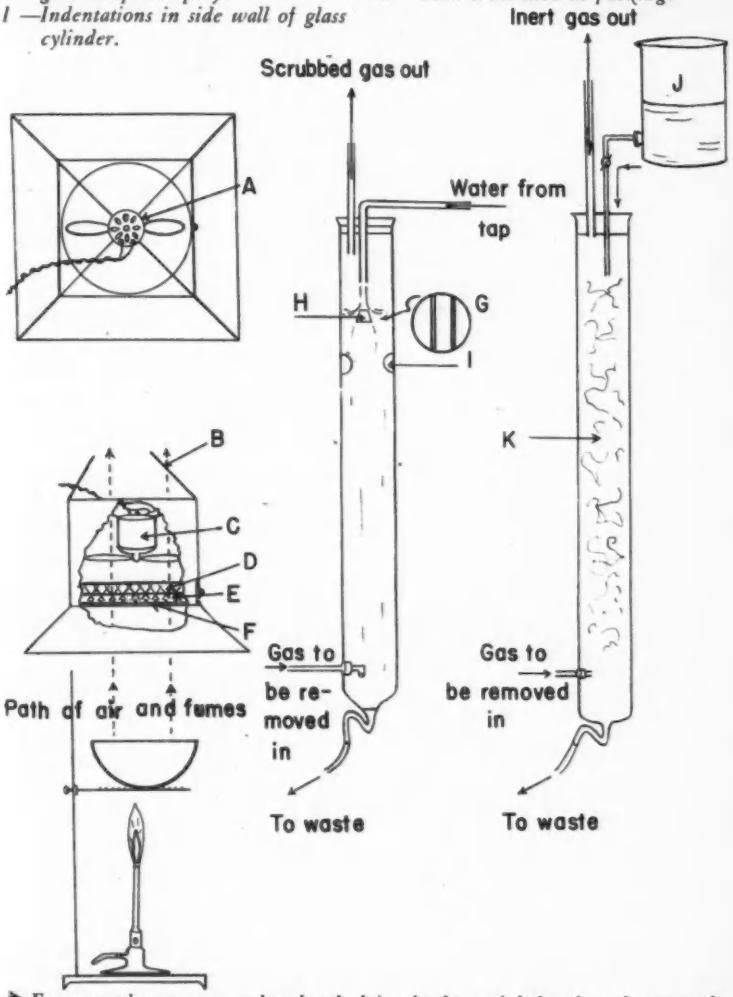
D—Layer of activated charcoal.

E—Layer of chemical absorption agent.

F—Sliding drawer with screen-covered bottom.

G—Cross-section of tube, showing arrangement of cork plug.

H—Cork plug to deflect water and give adequate spray.
I —Indentations in side wall of glass cylinder.
J—Solution used in absorption.
K—Glass wool used as packing.



► *Fumes and vapors may be absorbed in the home lab by these home-made contrivances described on the opposite page by Aloys L. Tappel.*

Two Recent Disasters Caused by Detonations

Explosions in the News

Chemical accidents on a large scale have caused the violent deaths of many persons during recent weeks, notably in Texas City, Texas, and Centralia, Illinois. There is always anxiety on the part of the public in such cases to know what conditions were the probable cause of the disaster and what precautions can be taken in the future to avoid a repetition of it.

Science Service staff writers, at the time of these explosions, interviewed experts whose lives have been devoted to problems of handling dangerous materials safely. Counsel of such experts, explaining what probably happened in the recent disasters and what to do for the future, is grouped here.

From one point of view, regardless of the material involved, these explosions are alike. They consisted of sudden rearrangements of molecular forces resulting in gaseous products which were violently expanded by the heat given off by chemical reaction. Damage to property resulted from these causes, destruction of life from them also, plus the suffocating and poisonous nature of the gases formed. It is of the greatest importance that people handling chemical materials recognize the potential hazards locked up in seemingly harmless substances.

Texas City

➤ A CHEMICAL MYSTERY, unsolved after decades of investigations, is why ammonium nitrate explodes violently as it did in the ship at Texas City, yet won't explode when hammered or penetrated with high powered rifle bullets.

The chemical villain in the Texas disaster is a harmless-looking white salt. It is not even classed as an explosive. It is usually safe to handle. A hundred million pounds are manufactured each year, for fertilizer or explosives use.

Only infrequently does ammonium nitrate go off with great violence, as it did at Texas City and as it did at Oppau, Germany, in 1926.

As a leading explosives expert put it: "When ammonium nitrate explodes, it is always mysterious."

Often slightly wet from moisture it has drawn from the air, the white crystals cake like table salt on a humid day. The caked masses often become so hard that workmen use iron picks and shovels to break them up. They pound the lumps with hammers. As a demonstration of the chemical's safety, they have even shot high-powered rifle bullets into a mass of the salt. Very special kinds of detonaters are required to set off blasting powder made of ammonium nitrate, and no amount of shock is known to have caused the pure salt, uncon-

taminated with any other material, to explode.

Neither will ammonium nitrate burn. This is expected from chemical theory, for burning is, in general, combination with oxygen, and the salt already contains a considerable quantity of that element. Even when heated to the ordinary degree in chemical processes it will take up no more.

It is another story, however, when the ammonium nitrate is contaminated with burnable material. Organic matter, chips of wood from packing boxes, fuel and lubricating oil dripping from carelessly closed containers, any of the combustible waste and dust constantly underfoot, mixed with the harmless-looking salt, makes a mixture where conditions are just right for a fire.

Organic material is made largely of carbon, often combined with hydrogen into forms which need to be heated only slightly to catch fire and burn in the oxygen of the air. We are so used to the fact of fire that we seldom think of the dangerous flammability of common materials.

Ammonium nitrate is, in comparison with most materials, not flammable by combining with the oxygen of the air. But when mixed with material that is flammable it helps combustion by giving up its own oxygen to help the fire along.

Exactly what happens when ammonium nitrate is heated to a high temperature is still unknown, for when it "lets go" the whole mass explodes, and there are seldom any survivors to report what happened. By violent rearrangement of the molecules, huge stores of energy are let loose in an instant. Flame and hot gases spread destruction to other burnable materials, and a holocaust like that in Texas City is the result.

It is natural to compare the destruction to war damage, for essentially the same chemistry is involved. The ammonium nitrate which blew up the French ship *Grandcamp* was probably salvaged from war-time ammunition. For military use, the hazards of explosive material have been purposely increased. The energy-giving salt has been mixed with unstable chemicals to make explosives still more dangerous.

A question often asked is, "How does this explosion compare with that of an atomic bomb?"

To the explosives chemist, who measures time in much shorter units than anyone else, the two types of explosion are very different. The huge vertical wall of blast pressure that moved out from Bikini was quite unlike the slower-moving wave set off by those types of ammonium nitrate explosives which have been thoroughly studied. Frequently used in coal mines for its effect in "heaving" rather than shattering coal, ammonium nitrate, making up as much as 95% of some blasting powder, is considered slow and safe, as explosives go.

For the future, explosives experts feel that no additional regulations are necessary, so far as pure ammonium nitrate uncontaminated with organic material is concerned. Stock of ammunition being reworked for agricultural use must always present more hazard than the newly formed chem-

ical which has never been mixed with explosive material. Care in handling the salt will always be needed because, as one chemist put it, "Wood that has been soaked in ammonium nitrate burns very nicely."

The harmless aid to agriculture turned its other face to the world when it exploded aboard the French ship in the harbor at Texas City, destroyed the vessel and triggered the destruction of a highly inflammable industrial town.

Texas City is in the heart of a chemical area making products largely from petroleum. It was the center of great oil tanks, containing crude oil, gasoline, aviation fuel and other petroleum derivatives for tanker shipment or for use in local refineries or chemical plants.

One of its chemical plants was that of the Monsanto Chemical Co., first to suffer from the explosion on the vessel. This plant produced during the war some 20% to 25% of the styrene used in making synthetic rubber. Styrene is highly inflammable but not explosive. Fire spread from it to the Pan American Oil refineries, with its great storage tanks, and to the plant of the Carbon and Carbide Company.

Because the destroyed Monsanto plant was a chemical plant, there was some misapprehension that the ammonium nitrate involved in starting the disaster was associated in some way with Monsanto. A report issued by Edgar M. Queeny, chairman of Monsanto's board, explains that Monsanto does not use in any way this chemical. The facts about the hazards of the Texas City plant are set forth as follows:

"Our Texas City plant did not use or manufacture ***any*** explosives. Several inflammable products such as benzol and propane constituted its raw materials. It manufactured monomeric styrene and polystyrene; the former is inflammable but the latter will only support combustion like wood — the distinction between an explosive and an inflammable material being that the former can be detonated on impact and the latter bursts into flame when ignited.

"There were not major explosions in our Texas City plant. None of the minor ones, described by our surviving staff as 'puffs' was great enough to cause any damage outside our plant area. The main fires in our plant were in the storage tanks and tank cars of benzol, propane, and ethyl benzene, an intermediate in the manufacture of styrene.

"Our Texas City operation was not considered a hazardous one—no more so than oil refining, which it resembled. It carried the same insurance rates as oil refineries.

The Texas City disaster has stimulated the National Board of Fire Underwriters to undertake a new research project covering the properties of ammonium nitrate with relation to fire and explosion hazards.

Underwriters Laboratories in Chicago will conduct the project and President Alvah Small outlined the project as follows:

"Two somewhat related research projects have been handled previously. The earlier one of these is the subject of a research bulletin

which relates to the use of ammonium nitrate as a fertilizer base; the later one was conducted for the account of the War Production Board which has now consented to the publication of our report as a research bulletin, the printer's copy for which is in preparation. It so happens that in neither of these reports is there account of exploration of ammonium nitrate per se with respect to the possibility of detonation from fire exposure.

"It is quite certain that various others will undertake investigations, by research methods, of certain aspects of these hazards. We hope, in due time, to be informed of the progress and findings resulting from most of such efforts and because of the recent occurence in Texas are confident that organizations representing capital stock insurance will contribute to the best of their ability."

Centralia

▶ THE EXPLOSION in the Centralia, Ill., coal mine in March that took the lives of many persons could have been due to either gas or coal dust in the air. Immediate death was probably caused by poisonous carbon monoxide resulting from the combustion of the explosion.

Carbon monoxide is the fatal odorless gas that forms from the incomplete combustion of organic matter which often occurs when the available oxygen exists in insufficient quantities. It is the so-called coal gas from household stoves that has taken so many American lives. It is also the poisonous material in the gases escaping from automobile exhausts.

Most explosions in coal mines are produced by the ignition of mixtures of methane gas, known to miners as fire-damp, with air, or of very finely divided particles of coal dust suspended in the atmosphere. Ignition may come from a miner's faulty safety lamp, a match used by a smoker, an electric spark from electrically operated equipment, or from a blast in a drill hole set off to loosen the coal which may be defective in one way or another.

Blasting in mines is usually carried out just after the men have completed their shift and left the mine. Before the next shift of miners arrive, dangerous gases and dust are removed by the ventilating system. In some types of mining sprinklers are used after blasts to clear the air. Blasting is usually postponed until the men are entirely out of the mine, or until they are far away from the danger area if an explosion occurs.

Methane or fire-damp, is often known as marsh gas because it forms where vegetable matter decays under water and is often seen as bubbles arising to the surface in swamps and marshes. It is a simple compound of carbon and hydrogen. It sometimes issues from coal seams in mines, mixing with the air to form a dangerous explosive. It constitutes 80% of natural gas, and it is found in petroleum. It is possible, therefore, that quantities of natural gas had escaped from undetected leaks in the oil well casings of the wells drilled through this mine.

Not all coal mines contain coal dust that is susceptible to easy ignition. Dangerous dust is formed in some but not in others. Clean coals, containing a high percentage of volatile combustibles, are especially dangerous. When coal dust in suspension is ignited, the explosion propagates itself throughout the dust zone by a shock wave that raises more dust as it travels. The explosion may, therefore, extend far beyond the immediate region of the working face.

The nation's coal mines can be made safer, but it is a job which will need men, money and stricter enforcement of mining codes.

Safety in coal mining means primarily good ventilation, the prevention of mine roofs from falling, dust-laying, and the use of proper explosives, handled only by experts, in the necessary blasting to loosen the coal from its seams. There are other necessary steps, but these are the most important.

Falling roofs in coal mines cause more fatalities each year than any other type of accidents. They are prevented, or at least lessened, by what is known as timbering or shoring. This means the placement of supporting columns in newly excavated cavities as rapidly as the cavities are made. It is an expensive job, requiring much skill, labor and timber. Constant inspection must be made to see if additional timbering is needed. Even with the best of shoring some roof falls are apt to occur. Men are sometimes injured also by debris loosened from the walls or faces on which the miners are working.

Explosions rank second as causes of mine fatalities. They may be of gas or of very fine coal dust. Ventilation is the method by which the explosive gases are removed, and ventilation also removes much of the coal dust that is suspended in the air. Powerful forced ventilation is required. Under the government mining safety code, giant blowers are stationed outside the mines to force fresh air down special conduits into the mine and to each group of miners. Separate conduits remove the foul air, together with any gases that have collected and with the suspended coal dust.

Settled dust, on the walls and roofs of coal mines, is often worse in an explosion than the minor amount of suspended dust in a properly ventilated mine. The shock waves that result from what may be a minor explosion drive this settled dust into the air where it in turn adds to the explosion.

Rock dust is the best known preventive. Rock dust is a noncombustible, specially treated pulverized limestone that is applied to the walls and roofs close behind where miners are working. It prevents the accumulation of dust on the surfaces. While limestone dust alone is sometimes used, a more modern practice is the use of a limestone dust that has been so treated that every tiny particle of it is coated with a water-resisting material. Such dust is sometimes scattered by automatic devices in the air ahead of an approaching explosion, in which case it is often effective in halting the explosion's progress.

Alcohol

by Burton L. Hawk

Purpose . . .

In the preparation of many organic compounds, especially those of aromatic nature, it is necessary to use pure ethyl alcohol. But, try and get the alcohol! In order to make it unfit for human consumption, the Government requires that alcohol be denatured for industrial use. This is usually accomplished by the addition of methyl alcohol, pyridine, or other petroleum hydrocarbons. And unless you are a licensed pharmacist or can supply other proof that it is to be used scientifically, it is very difficult to purchase pure, undenatured alcohol.

In view of the above, the home chemist has one alternative, and that is to produce his own alcohol. Even then he must remember to use his product solely for scientific purposes!

Technicality . . .

Yeast is composed of living cells, which produce bio-chemical substances known as *enzymes*. One of these enzymes, *zymase*, is responsible for the transformation of simple sugars (such as dextrose, glucose, levulose, etc.) into carbon dioxide and alcohol: $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$. The more complex sugars, such as sucrose (cane sugar), maltose, etc., are first changed into the simple sugars by the enzyme, *invertase*, also produced by yeast: $C_{12}H_{22}O_{11} + H_2O \rightarrow 2C_6H_{12}O_6$. The alcohol is then formed as before by the action of zymase. Therefore, a variety of sugars can be used to produce alcohol—cane sugar, molasses, corn syrup, dextrose, malt, etc.

Preparation . . .

For home preparation, table syrup is perhaps the most convenient to use. Prepare 500 cc. of solution, using one part syrup to three parts water. Crush a yeast cake in a small quantity of warm water making a thin paste, and pour into the syrup solution. Stir; let stand in a warm place for a few days, and let Nature do the rest!

After fermentation has taken place, pour off a portion of the liquid being careful not to stir up the yeast sediment. Transfer to a distilling flask and distill the liquid at a temperature of about 85°. If you have a Liebig condenser, it can be very conveniently used for the distillation. If not, a glass tube leading to a container externally cooled will suffice. A thermometer should be inserted through the stopper of the distilling flask for temperature control.

Tests . . .

Perhaps the simplest test is to determine whether your alcohol will burn. Apply a lighted match to a small quantity of the liquid in a watch glass. If the match is extinguished, it is obvious that the percentage of alcohol is not very high. In this case, it is advisable to redistil, being careful not to heat too strongly.

Next, you can perform the acetate test. Stir a few cc. of the alcohol with

an equal quantity of acetic acid (or a few crystals of sodium acetate). Add a small portion of sulfuric acid and warm gently. You will soon recognize the fruity odor of ethyl acetate . . . sometimes referred to as "banana oil," (although banana oil is actually isoamyl acetate).

Finally, you can confirm the above by applying the oxidation test. Prepare a solution of chromic acid by adding 1 cc. of con. sulfuric acid to 5 cc. of a concentrated solution of potassium dichromate. Warm gently, and add a small quantity of alcohol. The chromic acid oxidizes the alcohol to acetaldehyde which can be readily recognized by its odor. The solution turns dark green.

If you are convinced your product is truly alcohol, bottle it and save for future experiments.

Uses . . .

Industrially, it is used in the manufacture of celluloid films, artificial leathers, varnishes, shellacs, and hundreds of other similar products.

Commercially, it is sold as a fuel and is widely used as an anti-freeze, in burners, and as a solvent.

Medically, it is employed in the preparation of ethylene, chloroform, ether, iodoform, tinctures, and in numerous medicines. Externally as a rubbing compound and sterilizing agent. Internally, as a stimulant, narcotic and stomachic.

Socially, its use in wines and liquors is well known.

Morally, its use is frowned upon . . . "wine is a mocker, strong drink is raging: and whosoever is deceived thereby is not wise . . ."

Solid Alcohol

You no doubt have heard of "canned heat", which is usually a form of solid alcohol. It can be made from soap and alcohol, although more conveniently in the home lab by using calcium acetate. The alcohol should be of fairly high concentration (denatured alcohol can be used in this case). Prepare a saturated solution of calcium acetate and add to it a small quantity of alcohol. The solution will solidify into a jelly-like mass. Transfer a portion of the solid to a watch glass and ignite.

The Green Flame

Dissolve as much boric acid as possible in a small quantity of alcohol, heating if necessary. If the alcohol is now ignited, it will burn with a green flame.

New Mineral Has Three Rare Elements

➤A NEW MINERAL, nuevite, was given a Sunday christening recently by its discoverer, Dr. Joseph Murdoch of the University of California at Los Angeles. It is named for the town of Neuvo, Riverside County; Dr. Murdock found the first specimen in a silica quarry near there.

Nuevite is described as a heavy, black shiny material, containing the three rare elements yttrium, titanium and tantalum, together with iron. Although classified as a rare-earth mineral, its spectral analysis shows no uranium. Because of its scarcity, commercial uses are unlikely.

Vitamins, Antibiotics, Drugs
Promise New Cures and Protection

Chemicals Against Disease

From the laboratory and chemical plant to the clinics, new drugs or old in new roles go for testing and experimental use, first on animals, then on human cases if they seem promising. Here are some of the latest developments gathered from the frontiers of medicinal chemistry.

Vitamins

Against Spotted Fever

➤ DEATHS from Rock Mountain spotted fever, a tick disease, may be wiped out by modern treatment including doses of one of the B vitamins, para-aminobenzoic acid.

Rapid recoveries occurred in four out of five patients for whom Dr. Samuel F. Ravenel of Greensboro, N. C. used the new treatment. The fifth patient also recovered, but almost died due to what Dr. Ravenel terms "improper handling" of the case as regards the use of para-aminobenzoic acid.

"The astonishing thing about these patients," Dr. Ravenel stated in his report to the Journal of the American Medical Association, "was the amazing speed with which the temperature dropped, the rash faded and recovery ensued as soon as adequate concentrations of para-aminobenzoic acid in the blood were achieved."

One boy who might have been expected to be extremely sick for two to three weeks had a normal temperature and rapidly fading rash on the sixth day of treatment. An exceedingly ill, delirious child who would, before the days of para-aminobenzoic acid treatment, have been expected to have high fever for two weeks, had a normal temperature and rapidly fading rash on the fourth day of treatment.

The drug was given by mouth in a solution of sodium bicarbonate. A preparation of it can be given by hypodermic injection at the start of treatment in unconscious or vomiting patients.

Para-aminobenzoic acid alone is not the "sole answer" to the problem of treating Rocky Mountain spotted fever patients, Dr. Ravenel points out. Supportive treatment in the form of fluids, other vitamins and salts should be given. Possible toxic effects of the drug and complications of Rocky Mountain spotted fever should be watched for.

Against Pernicious Anemia

➤ A NEW vitamin is waiting to be discovered. It exists in liver and will help pernicious anemia victims. It might be called, when discovered, the anti-nerve-degeneration vitamin because its function would be to prevent the nerve degeneration that develops in some patients with pernicious anemia.

Existence of the vitamin is suggested by studies reported by Dr.

Tom D. Spies of the University of Cincinnati and the Nutrition Clinic, Hillman Hospital, Birmingham, Ala.

Synthetic folic acid, newest member of the vitamin B family, acts as an important blood builder in many kinds of anemia, including pernicious anemia. It cannot, however, be counted on to protect against the nerve degeneration that sometimes develops in pernicious anemia. The condition begins with the feet and hands tingling and "going to sleep" and may go on until the patient is incapacitated or paralyzed if not treated. Adequate amounts of potent liver extract protect against it.

"These observations suggest there is another important nutrient awaiting discovery," Dr. Spies said. "Many anemia patients who become allergic to liver extract can be safely and securely treated with folic acid as long as they do not develop nerve degeneration."

The anemias of sprue, pellagra and pregnancy and nutritional macrocytic anemia are all helped by folic acid.

It is amazing to Dr. Spies that patients with tropical sprue, who subsist on a diet composed almost entirely of starchy foods, regenerate blood when they are given folic acid even when they continue to eat such a diet.

Against Bleeding

➤ WHEN BLEEDING starts up two or three days after a tooth has been pulled, it probably is because the patient has been taking aspirin or some related drug to relieve pain.

Studies showing this are reported by Dr. Gustav William Rapp of the Chicago Dental College, Loyola University, in the Journal of the American Dental Association.

It should be possible to prevent the delayed bleeding, Dr. Rapp states, by giving proper doses of synthetic vitaman K, the so-called anti-bleeding vitamin.

Patients who have considerable bleeding after removal of tonsils probably owe this to the aspirin they have been taking to relieve the pain after the operation, Dr. Rapp points out, referring to a report by another scientist, Dr. Rudolph Singer of Vienna who joined the U. S. Army Medical Corps.

Dr. Singer made what Dr. Rapp calls "the remarkable observation" that the high frequency of hemorrhage after tonsil removal in America as contrasted to its infrequent occurrence in Europe is probably because American doctors prescribe acetylsalicylic acid, (aspisin) alone or with other drugs, for relief of pain after the operation. European doctors almost always prescribe a different drug, aminopyrine (Pyramidon) for this purpose.

Salicylic acid, Dr. K. P. Link and associates at the University of Wisconsin have discovered, causes a deficiency of prothrombin in the blood. When there is too little prothrombin, the blood clots slowly. Bleeding is prolonged and the clot formed is fragile.

Vitamin K can overcome this because it stimulates production of prothrombin.

Following these clues, Dr. Rapp made some tests on 40 apparently normal students. He gave some of

them tablets containing acetylsalicylic acid, acetophenetidin and caffeine, such are prescribed by many dentists for relief of pain. He gave others the same tablets plus tablets of synthetic vitamin K. Just before this and every day for six days after, he tested their blood for prothrombin.

Those getting acetylsalicylic acid mixture developed an acute deficiency of prothrombin in their blood. This showed up within one and one-half to two days after taking the tablets. It lasted for longer than five days. The clotting time in these students was nearly double the normal.

The prothrombin deficiency could be prevented by taking synthetic vitamin K with each tablet of the acetylsalicylic acid mixture.

Penicillin

Against Syphilis

➤ PENICILLIN may be the long-sought "magic bullet" which not only cures syphilis but prevents the disease. It works in rabbits and probably will work in man.

Work on penicillin as a prophylactic agaist syphilis was done by Drs. Harry Eagle, Harold J. Magnuson and Ralph Fleischman of the U. S. Public Health Service, the Johns Hopkins School of Hygiene, Baltimore, Md., and the University of North Carolina.

One or two tiny doses of the yellow mold chemical, injected within a few days after exposure to syphilis, would prevent the disease from developing if humans respond as the rabbits in Dr. Eagle's laboratory have.

The germs of syphilis, called spirochetes, are stopped by the penicillin after they have invaded the body but before even the first sore of the disease has developed.

Whether penicillin will prevent syphilis from developing in people who become infected with its germs will not be known for at least two years. Doctors could have the answer in three or four months if it were not for the prudish, hush, hush attitude many people still have about this disease which attacks a quarter of a million people every year.

To get the answer quickly, it would be necessary to shoot living syphilis germs into human bodies, as they were injected into the rabbits. Then half the human rabits would be given penicillin. The other half would not. If none of the first group group got syphilis, and most of the second group did, it would prove that the penicillin prophylactic treatment had been successful. Those who got syphilis could later be cured by regular eight-day penicillin treatment now used for syphilis.

Stopped by prudery from making this quick, critical test, Dr. Eagle is already planning for the two to three year test. This will be made by trying to reach contacts of syphilis patients who come to the clinic. The contacts wanted are the men and women, boys and girls who were exposed to the disease by the patients, not the ones from whom the patients got the disease. These contacts who probably have caught the germs but have not yet developed the disease

will be given the prophylactic doses of penicillin. But it will take a long time to find and treat enough of them so that the results will be conclusive.

It will be necessary for large numbers because, for one thing, not every contact would necessarily get syphilis. There is no way of knowing which ones would get the disease until the first sore appears. The most sensitive tests for syphilis now available do not give positive results until a week or ten days after the primary sore appears. The time between the invasion of the germs and the development of the disease, called the incubation period, is 2 days. This period has been set from histories of cases in which the doctors were able to learn the date of exposure and germ invasion and the date of the first symptoms.

Studying the effects of various doses of penicillin given to rabbits during this incubation led to the discovery of the prophylactic action of the mold chemical. The rabbits were given a definite number of syphilis spirochetes. Then different-sized doses of penicillin were given at different times after the germs. From these studies Dr. Eagle and associates found that the amount of penicillin needed to cure syphilis is related to the number of organisms invading the body and the time after the invasion the penicillin is given. The greater number of organisms, the more penicillin is needed. Details of these studies are reported in the Journal of Experimental Medicine.

A military application of the discovery, if human trials prove successful, is one scientists are already speculating on. Soldiers likely to be exposed to syphilis could be given prophylactic doses of penicillin as they returned from leaves, as they were given sulfathiazole to check gonorrhea on return from leaves during the war.

Against Typhoid and Brucellosis

Better results in penicillin treatment may come from a new chemical. It causes a three-fold or better increase in penicillin concentration in the blood than is otherwise attained by a dose of the mold chemical.

The new chemical, called caronamide for short, was announced by Dr. Karl H. Beyer of Sharp and Dohme's Medical Research Division.

Caronamide was made to fit specifications for a compound that would check the rapid excretion of penicillin by the kidneys. In drawing the specifications for such a compound, Dr. Beyer took advantage of a known mechanism of kidney cells. One scientist who has made a long study of kidney physiology says it is the first time this mechanism has been taken advantage of for the purpose of treating disease.

The mechanism is the one by which cells lining little tubes in the kidneys, called tubules, can take penicillin out of the blood stream, transport it across the cell and dump it into the lumen or clear space in the tubule. Once in the tubule lumen, penicillin is rapidly excreted from the body. About four-fifths of each dose of penicillin is lost this way within two or three hours.

Previously scientists have tried to

stop this rapid excretion of penicillin by giving either diodrast or another chemical, p-aminohippurate, which are excreted by the same mechanism. Giving either of these with penicillin saturates the mechanism by a "mass action."

The penicillin excretion mechanism works through an enzyme. Scientists have been able to check the action of other enzymes by chemicals which successfully competed with the enzyme for other chemicals the enzyme required. So Dr. Beyer wrote his specifications for a chemical that would successfully compete with the kidney tubule penicillin excretion enzyme. Other specifications were for reversibility of the process, lack of effect on any other kidney mechanism and lack of toxicity.

Caronamide, or 4'-carboxyphenylmethanesulfonanilide, was synthesized to these specifications by the organic chemistry department of the Sharp and Dohme laboratories. Tests on dogs and humans showed that caronamide achieves the purpose for which it was made.

As a result, it is expected that penicillin will be more effective, and can perhaps be given in less frequent doses. Typhoid fever, brucellosis and subacute bacterial endocarditits, which is a kind of heart disease, are among the highly resistant infections which may yield to combined treatment with penicillin and caronamide.

Against Lameness

➤ PENICILLIN is helping the lame to walk again, at least if their trouble has been due to chronic germ infections of the bones.

A patient who for a long time had chronic tuberculosis of the knee joint and osteomyelitis of the thigh bone and the inner bone of the leg below the knee had excellent function of the leg at the end of a year, thanks to penicillin and surgical operations.

This and 57 other cases in which penicillin was used with surgery to clear up bone infections are reported by Drs. H. J. McCorkle, Henry Silvani and W. E. Stern and Miss Helen Warner, researcher, of the University of California Medical School.

The penicillin is given several days before operation. Then surgeons remove all infected bone tissue and penicillin is again given, this time until the soft tissues and bone are healed. Details of the treatment appear in the journal, Surgery, Gynecology and Obstetrics.

Streptomycin

Against Rabbit Fever

➤ STREPTOMYCIN can save life even before the doctor knows precisely what ails the patient. And it can practically wipe out deaths from rabbit fever pneumonia if given early.

These striking facts about the famous remedy extracted from microbes living in the soil were presented to members of the American College of Physicians' recent meeting by Dr. Hugh J. Morgan of Vanderbilt University Hospital.

The pneumonia that may come with rabbit fever, or tularemia, used to kill between 20 and 40 of every 100 patients. In a group of 27 patients treated with streptomycin, only

one died, Dr. Morgan reported. That death was not due to the tularemia pneumonia but to another condition.

One symptom of tularemia is an ulcer at the spot where the germs got into the body. Enlarged lymph nodes, called "kernels", are other signs of the disease.

In more than half the patients with tularemic pneumonia, however, there may not be any ulcers or "kernels." In that case the doctor could not be sure what disease he was treating until he had the results of laboratory tests. These tests take about two to three weeks. In some cases the patient may be dead before the tests show that he had tularemia.

Streptomycin is a cure for tularemia with or without the highy fatal pneumonia that may accompany it. But to save the patient with tularemic pneumonia, it must be given early.

Patients critically ill with pneumonia of undetermined cause, if they are in a region where tularemia occurs, should be given streptomycin at once, without waiting for results of tests.

Stilbamidine

Against Bone Marrow

➤ THE EXCRUCIATING pain of multiple myeloma is relieved and the course of this malignant bone marrow disease is arrested by treatment with two relatively new drugs and a low protein diet.

Dr. I. Snapper of Mount Sinai Hospital, New York, reports in the Journal of the American Medical Association that the treatment does not cure the disease. It is temporarily checked in its development. This occurs even in cases in which the disease has been rapidly getting worse before the treatment is started.

The two drugs Dr. Snapper has used are Stilbamidine and Pentamidine. Drugs of this type, which are diamidine compounds not containing antimony, have been successfully used since 1939 to treat the tropical disease, kala-azar. Before their development, antimony compounds were used for kala-azar and for multiple myeloma, leukemia and Hodgkin's disease. The reason for using the same drugs for these different illnesses was that in all of them there may be an increase in the amount of a protein called globulin in the blood serum.

All 15 patients Dr. Snapper has so far treated with either Stilbamidine or Pentamidine and a diet low in animal protein have shown considerable improvement. The improvement starts soon after the treatment is started, sometimes after the third or fourth injection.

One of the patients, a 59-year-old man, had lost 35 pounds in weight in the course of a year. Pain which started in his back and spread to both legs and feet was so severe that he complained continuously and could move in bed only with difficulty.

His bones were tender and abnormally porous and he had a large, gaping crack at the head of his right thigh bone.

Treatment with X-rays had not helped. He was given 19 Stilbamidine injections, starting on Feb. 18. On April 14 he was discharged and walk-

ed out of the hospital almost like a normal man.

Shortly afterwards he went back to his job as a porter and was still working at this job and in excellent general condition and far stronger than the average person when last seen by Dr. Snapper in October, 1946.

The disease is arrested but not cured, Dr. Snapper states, because even though he feels well and is active, his bone marrow, examined in May, 1945, still contained many myeloma (tumor) cells.

None of the 15 patients treated so far has had any relapse and all have been relieved of pain. Eleven were able to walk when discharged from the hospital. One has since died of diabetic coma, two others have died of myeloma of the kidney and thrombopenia, respectively, and one had paralysis before treatment started.

The effect Stilbamidine has in arresting the disease may be due to changes it produces in the chemistry of the myeloma, or tumor, cells. Another investigator, Dr. M. J. Kopac of New York, has reported that this drug destroys cancerous cells of transplantable animal tumors without damaging normal cells. The shape of the nuclei of the tumor cells was changed and cell division was stopped. Dr. Kopac believed the drug had a chemical influence on certain specific nucleoproteins of the cell nucleus.

Dr. Snapper found no change of the nucleoprotein of the nuclei of the myeloma cells in his patients, but did find changes in the cytoplasm of these cells, consisting of precipitates of ribonucleic acid.

Tryptophane

Against Tooth Decay

► Tests of a chemical that may become a new tooth decay preventive are now under way on a small group of human guinea pigs at Forsyth Dental Infirmary in New York.

The chemical is called tryptophane. It is one of the amino acids that are building blocks of proteins in meat, cheese, blood, and muscle. Its possible role as a tooth decay preventive was discovered by Mrs. Naomi C. Turner. Latest findings are reported by her and Dr. George E. Crowell in the Journal of Dental Research.

Children just over an attack of measles, mumps, infantile paralysis or other virus-caused disease may in future be given doses of tryptophane to protect their teeth from the decay that frequently starts after these diseases. This is suggested by one part of Mrs. Turner's studies.

Whether tryptophane will prevent tooth decay is not known yet. Mrs. Turner has already found, however, that it changes the saliva of persons with tooth decay to a saliva chemically more like that in persons who have no tooth decay.

Tryptophane also lowers the amount of sugar in the blood. This discovery was unexpected and is being further studied by an expert on diabetes. Until its exact significance is understood, Mrs. Turner feels that use of tryptophane for attempted control of tooth decay should pro-

ceed with caution. In her own experiments, the chemical is given as a white, crystalline powder in water midway between breakfast and lunch. It will take some time before results from these studies show whether or not tryptophane controls tooth decay.

First clue to the possible role of tryptophane in preventing tooth decay was discovered, surprisingly, because Mrs. Turner was making a three-year study of the common cold among school children. She was finding out things about colds that could not be explained, so she decided to go back to school herself and learn more biochemistry. In a laboratory study of the effect on starch of saliva, where cold germs might lurk, she found that her own saliva was different from that of the girl working next to her. She made the test on others in the class and found the difference was related to whether or not they had much tooth decay.

This difference, called "dextrinizing time," is in the rate at which the saliva converts starch into sugars. It is fast for saliva from persons with tooth decay, slow for persons without.

Another chemical difference in salivas from mouths with and without tooth decay is the rate at which the saliva takes the color out of preformed starch blue. From those with rampant tooth decay it takes an average of 13 minutes to turn the starch blue white. Saliva from those without caries does it in less than five minutes.

These and other studies lead Mrs. Turner to believe that tooth decay and freedom from it are associated with varying amounts of two enzyme chemicals in the saliva. The chemicals are called alpha and beta amylase and they play a role in changing starch into sugar. An enzyme more familiar to the layman is pepsin in the stomach, which plays a part in digestion of protein foods.

A little Negro boy who had the mumps gave the clue to the possible use of tryptophane to protect children's teeth after certain childhood diseases. When this little boy first came to the dental clinic, he had a "dextrinizing time" of 120 minutes and good teeth.

Some months later when re-tested, his dextrinizing time had dropped to 35 minutes. At this time, Mrs. Turner was using a new test for the dextrinizing time, and she thought perhaps it was a poor test and that was the reason for the conflicting results on the litttle boy's saliva. But when Dr. Crowell, her dentist associate, examined the boy's teeth the second time he found several new cavities. Questioning the boy's mother, they found he had had mumps in the time between the two tests.

Remembering that the mumps virus lives in the saliva-producing glands, Mrs. Turner began wondering whether the virus had something to do with the change in the boy's saliva and, consequently in the development of cavities in his teeth.

Then another little boy, Roland, came along with a fast dextrinizing time, indicating very bad teeth. But his teeth were perfect. No signs of cavities or decay was found. It took a bit of medical detective work to straighten that one out, because Roland and family had moved and three months elapsed before he was located.

When he was found, Mrs. Turner learned that two weeks before the dextrinizing time had been taken, he had had infantile paralysis, another virus-caused disease. And in the three months since the test, he had developed three cavities. Digging back into her records, she also found that Roland had been to the clinic two and one-half years before and at that time had a dextrinizing time of 80 minutes, which would be expected for good teeth.

Hormone

Against Ulcers

➤ A MEDICINE which helps stomach ulcer patients get well and stay well even after they have stopped taking it was reported by Drs. A. C. Ivy and M. I. Grossman, University of Illinois, to the American College of Physicians.

The medicine is called enterogastrone. It is a hormone chemical obtained from hog intestines. In the form now used, it is a white powder with a bitter taste which forms a light tan, clear solution in water. The patients get it by injection into the muscles, so they do not know about the bitter taste.

Enterogastrone is expensive. As now produced on a laboratory scale it costs about $2 to produce the amount needed for one patient for one day, although this daily dose amounts to only a few grains. Patients get the medicine six days a week for one year.

Because of this high cost, the number of patients on whom it has been tried has been limited. So far, 58 patients have been given the medicine. Dr. Ivy reported on 27 of them.

Results are "excellent" in 23 of this group. Although five had a return of ulcer symptoms during the course of treatment, they are all now free of such symptoms. Of the 27, five have been without symptoms for a year or more since they have stopped getting the medicine. One man has gone 25 months without ulcer symptoms and without treatment.

One 60-year-old man, who had ulcer attacks four and five times a year for 47 years, is now on his second course of enterogastrone treatment for return of symptoms. But for the first time in 20 years he was without trouble from his ulcer for a period of nine months.

Dr. Ivy emphasized the relapse-preventing effect of enterogastrone. With the usual medical treatment, about 60 out of 100 ulcer patients relapse within two years. With enterogastrone, the relapse rate is very much lower, and it is lower than it was previously in this group of patients.

Explaning what enterogastrone is, Dr. Ivy pointed to the common experience that a fatty meal causes the stomach to empty slowly. Experimentation has shown that, in the average person, when fat composes more than 10% of the volume of a meal, stomach movements are depressed and stomach emptying is slowed. Along with this there is a checking of the hydrochloric acid production by the stomach.

The fat, however, acts in the intestine, not the stomach, to check stomach activity. This stomach-checking action is due to a hormone, enterogastrone, released from the intestinal walls when fat is in contact with them.

Use of this hormone in treatment of stomach ulcer followed studies showing that hydrochloric acid and pepsin are factors which extend an ulcer and make it chronic, though they probably do not start the ulcer.

In other studies, it was found that an ulcer which occurs in 98% of dogs following a certain kind of operation could be prevented in all but 24% when they were given enterogastrone. In addition, ulcer failed to develop in all but two of 28 dogs in the usual time after treatment was stopped.

Radium

Against Asthma

➤ ASTHMA attacks have been completely banished in 15 of 34 children and reduced in number and severity in another eight of the 34 by radium treatment, Drs. Arthur T. Ward, Jr., Samuel Livingston and Dean A. Moffat of Johns Hopkins Medical School and Hospital have reported in the Journal of the American Medical Association.

The radium is applied by a special applicator to the region back of the nose and throat where the tonsils and adenoids grow. From two to six treatments were given. The treatment is simple and, when done by a trained operator, without danger. Many of the children were bothered by sneezing and nasal discharge for 12 to 48 hours after the treatment and some had asthmatic symptoms a few days later. The final results, however, were from total to 50% relief in 68% of the children. Good results were also obtained in hundreds of others given the treatment but whose cases are not reported in detail.

The radium treatments help by reducing the amount of lymphoid tissue, like overgrown adenoids, which many children and adults have. These same treatments have been used successfully to prevent or relieve deafness due to this overgrowth of tissue in the back of the nose and throat.

Persons who have had the treatment do not have so many colds and their colds are less severe. This may be part of the reason for the benefit in the asthmatic children. In most of those treated, the asthma attacks came after a cold.

After the lymphoid tissue has disappeared, the child may be less likely to absorb into his body the allergy-inducing substances that could bring on attacks of asthma. This is suggested by the Hopkins doctors as another possible reason for the benefit from the radium treatments. Many of the children were allergic, but eliminating the offending substances, change of diet, change of climate and attempts to desensitize them had all failed to help the asthma.

DDT

Against Lice

➤ DELOUSING the whole world is an entirely practicable project. By a well-planned and concentrated attack E. F. Knipling of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture believes it will be possible to make every kind of louse as extinct as the dodo or the dinosaurs.

This was proved dramatically by the anti-louse campaigns of the recent war. First success was in the development of the methyl bromide fumigation method, for Army uniforms. Climax was reached when DDT powder was used on the entire population of Naples, stopping cold a louse-borne typhus epidemic.

The Bureau now has two other louse-killers rated practically on a par with DDT; they are known as 3956 and chlordance. So if DDT-resistant strains of lice should develop, as resistant strains have arisen among other insect pests, these two new weapons can be used instead.

BAL is Gold Antidote

➤ AN ANTI-WAR GAS chemical is making gold salts treatment for arthritis safer. More than that, it may lead to even better treatment for rheumatoid arthritis.

This newest hope for arthritics is BAL. The letters stand for British Anti-Lewisite. Chemically, it is a kind of alcohol, 2, 3-dimercaptopropanol. Designed by British chemists to save soldiers in case of gasing with arsenic-containing lewisite, BAL turned out to be a life-saving remedy for victims of bichloride of mercury and arsenic poisonings.

Some arthritis patients have been helped by gold salts, but gold, like mercury and other heavy metals, is a poison. The gold salts treatment was dangerous because it was hard to gauge a dose that would help the patient but not poison him.

BAL has been given to a dozen patients suffering from gold poisoning following gold salts treatment for arthritis. In all but one the poisoning symptoms were relieved. In that one, the rash and itching was not affected by the BAL treatment. Two of the patients were seriously ill. "Spectacular recovery" occurred in each of these cases.

Details of this new use of BAL are reported in the Journal of the American Medical Association by three groups of physicians: Drs. Abraham Cohen of Philadelphia, Joel Goldman of Lewistown, Pa., and Alfred W. Dubbs of Allentown, Pa.; Drs. Charles Ragan and Ralph H. Boots of New York; and Drs. L. Maxwell Lockie, B. M. Norcross and C. W. George of Buffalo.

Hope of an even better treatment for arthritis appeared in the report by Drs. Ragan and Boots. BAL, they found, seemed to cause an earlier relapse of the arthritis in patients who had been free of the disease temporarily following the gold salts treatment.

Chemists Improve Materials Plan Gadgets, Save Waste

Novel and Useful in Chemistry

If you wish a copy of the complete specifications, send 25 cents (not in stamps) for each patent and order by number from the U. S. Commissioner of Patents, Washington 25, D. C.

Fluorinated Butadiene

➤ An improved type of synthetic rubber, especially well adapted for use in electric insulation, is the subject of newly-issued U. S. Patent 2,416,456. The inventor, Dr. L. Frank Salisbury of Wilmington, Del., has assigned rights to E. I. du Pont de Nemours and Company.

Hitherto, a special rubber for this purpose has been produced as a copolymer of chlorinated butadiene (chloroprene) with styrene. Dr. Salisbury substitutes chlorine's once-wild chemical cousin, fluorine, using essentially the same formulae and methods of preparation. The new compound has high resistance to the aging effects of sunlight and ozone and to the action of oil and other rubber solvents, remains highly elastic at low temperatures, and shows surprisingly high tensile strength.

Oxygen-Measuring Instrument

➤ Prof. Linus Pauling, one of the best known American chemists, has taken out patent 2,416,344 on a device that measures the relative amounts of oxygen in mixtures of gases. It depends on the known fact that oxygen is slightly attracted to a magnet, while most other gases are repelled.

The device consists of a pair of spheres connected by a slender rod, suspended between the poles of a strong magnet by a filament attached to the middle of the rod. Response of the spheres to the magnetic pull is conditioned by the oxygen concentration; the amount and rate of their swing is registered by means of a light beam reflected from a small mirror attached to the filament.

Dr. Pauling has assigned rights in his patent to the California Institute Research Foundation.

Fusible Vents Localize Fires

➤ A novel idea for localizing fires in large factory or warehouse spaces is embodied in patent 2,416,284, granted to Arthur L. Brown of Boston, assignor to the Factory Mutual Research Corporation. His design calls for the incorporation of panels of low-melting-point materials, such as fusible alloys, rubber compounds or plastics, into the roof structure. The idea is that if a fire can quickly make a hole in the roof it will not spread laterally, nor will smoke fill the building, preventing effective approach of firemen.

Sulfur Separation

➤ Sulfur is removed from crude or semi-refined phosphates, potash salts and other fertilizer materials in a process on which patent 2,416,663 was granted to A. B. Menefee of Cumberstone, Md., and H. H. Gregor of Washington, D. C. It consists

essentially in heating a mixture of the raw material and oil, or some other liquid that will not wet sulfur, to above the melting point of sulfur, and draining the sulfur out at the bottom. The remaining material is pelleted for use as fertilizer.

Ammonium Nitrate Crystals

➤ AMMONIM NITRATE, valuable alike for fertilizer and explosive purposes, has a bad habit of caking. R. C. Datin of Petersburg, Va., has obtained patent 2,416,615 on a process for producing it in crystalline grains of any desired size. Large, uniform grains are obtained when the operation is conducted at temperatures above 125 degrees Centrigrade, smaller grains at lower temperatures.

Glycerine By Fermentation

➤ GLYCERINE, needed in huge quantities for a thousand industrial purposes, is in short supply because of the scarcity and high price of fats used in soap-making, of which it has long been a co-product. Its production directly from sugars by yeasts or other microorganisms, though possible, has been attended with some difficulties. Newest effort to overcome these is embodied in U .S. patent 2,416,745, issued to a team of three micro-biologists, Prof. Ellis I. Fulmer and Dr. L. A. Underkofler of Iowa State College at Ames, and Dr. Richard J. Hickey of Terre Haute, Ind.

Ordinary yeast fermentation produces a little glycerine along with the ethyl alcohol. Addition of a soluble sulfite to the sugar solution upsets the fermentation chemistry in such a way that larger quantities of glycerin are produced. Carried on in an alkaline medium in the past, this production has still not been satisfactorily large because yeasts do not thrive on alkaline conditions. In the new process, the medium is acidified, making it possible for the yeast to work more efficiently.

Rights in the patent are assigned to the Iowa State College Research Foundation.

New Antibiotics

➤ THREE BRITISH microbiologists, C. E. Coulthard, W. F. Short and Robert Michaelis, have isolated a new antibiotic from the same mold that yields penicillin, Penicillium notatum. Their product, which is protected by patent 2,416,821, has been named notatin, from the second or specific name of the producing organism.

Two Britons, John H. Birkinshaw of Pinner and Stephen E. Michael of Croyden, have isolated a new antibiotic drug from Penicillium patulum and P. expansum, two molds related to the species from which penicillin is obtained. U. S. patent 2,417,584 has been issued to them on their product.

Prospecting Seismometer

➤ HERBERT HOOVER, JR., of Sierre Madre, Calif., son of the former president, has designed a new seismometer for use in geophysical oil prospecting. The movable member, which carries electrical coils to register its vibrations, is tightly sealed in a dome-shaped case, and may be used either upright or inverted. Rights in the patent, No. 2,417,077, are assigned to the United Geophysical Company, Inc., of Pasadena.

For Electron Microscopes

➤ AN ATTACHMENT for electron microscopes, which enables the ob-

server to watch and photograph changes in a specimen as its temperature changes, is covered by patent 2,417,213, issued to Robert G. Picard of Collingswood, N.J. It consists of a heating lamp in a cylindrical housing, to be thrust in through an opening in the electron microscope tube near the specimen, which will be heated by radiations focussed through a lens.

Another invention useful in electron microscopy is covered by patent 2,417,110, granted to Dr. James Hillier of Cranbury, N. J. He makes surface relief castings of specimens too thick for direct examination by coating them with a metallic bichromate gel, which is tanned by exposure to soft X-rays before it is stripped off and washed, preparatory to mounting in the electron microscope.

Rights in both the foregoing patents are assigned to the Radio Corporation of America.

Silk Plating

➤ WHAT IS in effect silk-coated cotton is provided in a process on which Thomas C. Whitner of Elizabeth, N. J., has obtained patents 2,417,388 and 2,417,389. He impregnates the cellulose fibers with a chemical mixture in which silk has been dissolved, then removes the chemical vehicle in an acid bath, finally rinsing out all residue with water.

Corrosive Resistant

➤ PACKING MATERIAL resistant to the almost universal corrosive, hydrofluoric acid, is made by James D. Covington of Dallas out of a mixture of talc and flake graphite. Rights in his patent, No. 2,417,351, are assigned to the Socony-Vacuum Oil Company.

Chemicals From Straw

➤ INDUSTRIAL SOLVENTS, fatty acids and other useful chemicals are prepared from straw by fermentation with soil bacteria through the process on which a London inventor, Charles Weizmann, has obtained patent 2,417,801. He has found that if the bacteria are "encouraged" with easily fermentable carbohydrates, such as the starch remaining in bran, or the hexoses obtained by the partial hydrolysis of the celluloses in straw, they will act on the remaining undigested cellulosic substances, with profitable results.

German Synthetic Cosmetics

➤ GERMAN WOMEN had their face creams, perfumes, hair tonics and shampoos during the war, thanks to German chemists.

When foreign raw materials became scarce, or no longer available, these scientists developed substitutes. Many of them were based on synthetic glycol waxes, and oily materials extracted from wool fat.

The methods are no longer secret. American investigators of Nazi war industries have collected the formulas. American manufacturers of cosmetics, and others interested, can get a complete report on German Cosmetics from the U. S. Department of Commerce (Report PB-47526, $3 for microfilm).

Chemical Things To Do

Test for Good Insecticide

by JOSEPH H. KRAUS

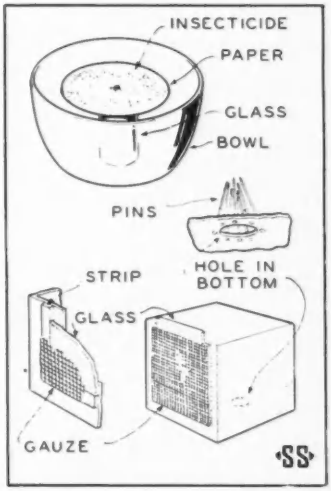
➤ WITH SO MANY insecticides on the market today, it is difficult to weigh their relative merits. Here is a simple way in which you can compare the killing properties of DDT, rotenone and similar substances when used either as liquids or dusts.

Let us compare the dusts first. From a piece of ordinary blotting paper cut a circle about six inches in diameter. Now in a sheet of plain paper cut a hole five inches in diameter. From the center of this disk fashion a circle three inches in diameter. The doughnut-shaped piece may be thrown away; the other two pieces you will use for the experiment.

On top of your circle of blotting paper place the paper disk and large piece from which the five-inch disk was cut. Center them approximately. Apply a layer of insecticidal dust in the one-inch space outlined by your pieces of paper and shake off the loose powder. The powder that remains on your blotting paper is to be used for your comparative tests. Now remove the paper masks.

Prepare a similar blotter for each of the dusts which you want to test. Mark each with the name of the dust as well as the date of the first trial.

Set one of these disks on an inverted glass in a large bowl. Drop at least ten crawling insects of the same kind in the center, one after the other. In an effort to scamper away, each insect will cross the ring of powder and drop off the edge of the blotting paper into the bowl.



Test several types of dust insecticides in this way. Note how many of the insects die and how long it takes.

Compare Paints

The relative value of insecticidal paints can be compared in a similar manner. Instead of placing the two paper cut-outs on blotting paper, however, dip cardboard or wrapping paper into the insecticidal paint and hang up to dry. Then cut out a one-inch disk over which the insects must crawl.

For flying insects it is better to use a screened box. First get a number of cardboard boxes of substantially the

same size, one for each of the insecticides to be tested. Cut a window in one side of each box and a hole in the bottom. Surround the bottom hole with a conically-arranged row of pins, as shown in the diagram. Now, when you put the insect near the hole, it will crawl or fly up into the box, but its exit will be prevented by the pins.

To Test Sprays

Around the window run three cardboard strips to serve as guides for a two-inch square of glass. Around the cardboard guides bend a piece of wire screening. You are now ready to test the effectiveness of any spray insecticides which need not actually hit the insect to knock it out.

After you have put the glass window in place, introduce ten or more insects of any particular type into the box. Dip the wire screening into the insecticide, shake off any of the liquid which fills the squares in between the wire, and let dry. Set the screening in place over the glass and remove the glass window. The insect coming in contact with the screen should die if the insecticide is any good.

When you have calculated the "kill" and recorded the length of time needed to deliver the result, you will have a pretty good idea of the effectiveness of the various insecticides. Repeat the experiment with the same screened boxes and disks of blotting paper at weekly intervals to determine how long the materials will keep their deadliness.

Golden Fleece Really Golden

➤ A SCIENTIST has come up with an explanation of the mythical Golden Fleece of Jason.

Prof. Arthur F. Taggart of the Columbia University School of Mines explains the Golden Fleece that Jason stole as probably the sheepskins used to line the bottoms of gold sluices.

He adds that the ancient sheepskin process is related to the modern flotation method, used to concentrate more than 100,000,000 tons of ore per year in the United States.

In the flotation process, small particles of different minerals are separated in an aqueous suspension, called a pulp. A froth of one mineral floats on top of the other and is overflowed or skimmed off. Without the process, declares Prof. Taggart, the copper, lead and zinc supplies of the country would have been more than critically short in the last war, and many less common metals and minerals would have been unavailable.

Heart of the process is the selective production of a hydrocarbon-like film on the particles in the pulp which are to be floated. The sheepskins, which were probably the basis of the ancient myth about the Golden Fleece, owed at least a part of their effectiveness as gold collectors to the natural grease they contained, Prof. Taggart points out.

One of the original jeeps built in 1940 for the Army is now in the Smithsonian Institution at Washington; another, that served two years on Guadalcanal, is in the Marine Corps museum at Quantico, Va.

Hungry Are Fed, Lives Are Lengthened By New Research Advances

Food, Farm, Factory, Table

➤ GET ON the carrot wagon if you want to add an extra 10 years to your life at its prime.

This advice seems justified on the basis of latest nutrition studies by Dr. Henry C. Sherman of Columbia University. Rats given four times the normal amount of vitamin A in their diet lived more than 10 per cent longer than their life expectancy. And carrots are a very rich food source of vitamin A for humans.

The increased length of life comes at the prime of life in the rats and would in humans, too, Dr. Sherman thinks. The rats with the extra vitamin A grow more rapidly and more uniformly and have more vigorous offspring.

Vitality is higher and death rates lower at all ages. Full adult capacity, or the prime of life, is reached earlier and kept longer. Life expectation is increased not only for the young but also for grown-ups.

"The previous general progress of public health had increased the life expectation of the infant but not of the grown person," Dr. Sherman points out. "Now the nutritional improvement of the norm raises the life expectation of the adult as well.

"The extra years thus offered are not to be pictured as added to old age. Rather it appears that something like an extra decade can be inserted at the prime or apex of the life lived in accordance with today's newer knowledge of nutrition. Life becomes longer because it is lived on a higher health level throughout. The apex of attainment is higher, the period of prime is longer and, in human terms, there is a smaller percentage of years of dependence."

The basic diet to which Dr. Sherman added extra vitamin A and got longer-lived rats had the same relation between amounts of vitamin A and calories as that recommended as a good diet for humans in 1941. So if you are going to add a decade to your prime, you will eat four times the recommended amounts of carrots and other yellow vegetables and fruits and green, leafy vegetables and liver.

Dr. Sherman, whose studies are supported by grants from the Nutrition Foundation, the Markle Foundation and Swift and Company, is now trying to learn what further benefits can be achieved by increased amounts of calcium in the diet and by improving the relation of meat and other protein foods to phosphorus and the B vitamin, riboflavin.

Farm Research Profitable

➤ AMERICA'S best investment probably is not in industry or gold mines but in the search for more and better hogs, corn and other farm products. Dollars spent by the government on agricultural projects now yield as much as 100 times the cost of the studies in increased and improved crops. Dr. W. V. Lambert, chief of

the Agricultural Research Administration of the U. S. Department of Agriculture, has balanced the books on the nation's expenditures for farm research.

The return from a few tens of millions of dollars spent during recent decades in scientific study of only a few agricultural problems now totals approximately $2,500,000,000 in additions to the nation's farm income.

Some items from the "books" of agricultural research as listed by the chief of the Agricultural Research Administration:

Hybrid corn: took about $10,000,000 to develop, over a period of 30 years; increased income from hybrid corn now totals $750,000,000 each year.

DDT: from $50,000 spent in research, the profit in improved production from dairy cows relieved of biting flies now runs to $10,000,000 yearly and figures may even jump to $100,000,000.

Pigs: research on the prevention of roundworms cost $25,000; annual value now amounts to $25,000,000.

Phenothiazine: this chemical controls internal parasites in livestock; development cost $10,000, and the farmers get back $10,000,000 each year in faster-growing animals which require less feed.

Other "annual earnings" of agricultural research include $1,000,000,000 from development of disease-resistant varieties of grains and sugar crops and $500,000,000 estimated yearly return from improved dairy practices.

Farm science has produced important dividends in human lives from finding how to produce penicillin on a large scale and studies in the field of human nutrition.

Special Diets for Special Jobs

➤ YOUR DOCTOR may some day in the future prescribe a diet for you according to your particular job. Workers in automobile plants might get one kind of diet, while workers in the paint industry or in dye houses would get other diets.

Whether special diets could protect workers from illness and what such diets should be are subjects of a long-range research project at Columbia University. Dr. Leonard J. Goldwater is in charge of the research under a grant of $11,000 from the U. S. Public Health Service's National Institute of Health.

"It has long been known," Dr. Goldwater said, "that individual workers in the rubber, automobile, paint, dye and other industries show marked variations in the way they react to harmful dusts, gases and fumes. Some are relatively unaffected, while others become seriously ill. Present treatments for these occupational illnesses are largely unsatisfactory.

"There have been sporadic reports that vitamins and other nutritional factors may play a part in determining whether workers are susceptible or resistant to harmful atmospheric contaminants. We intend, therefore, to expose white rats fed on various types of diets to all the different types of toxic fumes found in industries manufacturing chemicals, dyes, solvents, explosives and other products. The variable nutritional substances to be added to the rats' diet will con-

sist mainly of vitamins, proteins and minerals."

Soldiers Want Protein

➤ A SOLDIER wants about one-tenth of his daily food to be meat or other protein foods, whether he is sweltering on a Pacific island or enduring the Arctic cold. And he eats from one-third to two-fifths of his food as fat, given a chance to eat all he wants from a wide variety of rations. But he eats a good deal more in the Arctic than in the tropics.

These findings were made by Drs. Robert E. Johnson, now at U. S. Army Medical Nutrition Laboratory, Chicago, and Robert M. Kark at the Harvard Fatigue Laboratory, Boston.

In the desert with the temperature 92 degrees Fahrenheit soldiers each ate 3,100 calories daily on the average. In the Arctic at 30 degrees below zero Fahrenheit, they consumed 4,900 calories daily. But the proportion of protein and fats chosen to the total calories remained about the same.

Man and Rat Vitamin Factories

➤ A MAN AND A RAT can do something that microorganisms cannot, except in one case. A microscopic creature named Acetobacter suboxydans is the sole member of his kind to be able to turn pantothenyl alcohol into the B-complex vitamin pantothenic acid.

But man and his experimental opposite number, the laboratory rat, can do it with ease, according to Dr. Saul H. Rubin, director of the nutrition laboratories of Hoffman-La-Roche, Nutley, N. J. He reported his joint researches with Dr. J. M. Cooperman, Miss M. E. Moore, L. Drekter and J. Scheiner, to the American Chemical Society.

Dr. Rubin stated that pantothenyl alcohol, which is more stable and satisfactory than the acid to use in pharmaceutical preparations, is changed in the body of a mammal to the acid form which the body needs, with full vitamin activity. This allows the pharmaceutical manufacturer to put the vitamin-forming alcohol into his preparation, where it will stay unchanged until the patient swallows it and makes his own pantothenic acid out of it on the spot in the place where it is needed.

Allergy Eczema

➤ FOOD ALLERGY appears to be the cause of most cases of eczema of the hands.

In 80 cases of eczema of the hands, Dr. Albert H. Rowe, University of California Medical School cleared up the condition by removing the guilty foods from the patient's diet. To prove his point he had the patient eat these same foods again. A new outbreak of eczema followed.

This does not eliminate other causes of eczema, such as inhalation of pollens and dust or the irritants contacted in various occupations, but it places a new importance on the role of food allergy.

The physician's treatment, consisting of a diet eliminating the allergenic foods but protecting nutrition and weight, usually began to show results in about two weeks, the period in which the guilty foods are eliminated from the body.

The skin usually became normal. Redness, itching and scaling remained in some cases, usually because of breaks in the diet, impossibility of eliminating all allergenic foods, or

secondary reactions produced by soap, water, heat, sun, wind or chemicals.

Irritations of the skin of the hands, such as contact with industrial irritants or household chores, including cooking and washing, were found by the physician in some cases to trigger the food allergy into eczema.

This is illustrated by the fact that 80% of Dr. Rowe's food-sensitive patients were women. Most housewives were able to resume their chores without ill effect after the primary cause of the condition had been removed, however.

Dr. Rowe said that food allergy in dermatitis of the hands cannot be diagnosed by skin testing, and he suggested routine use of trial diets to determine the cause.

He said that there need not be a personal or family history of food allergy in these cases. Dermatitis from food allergy usually increases in the fall, winter and spring months.

Jet-Tenderizing Meat

➤ BEEFSTEAKS and other meats that are a trifle tough won't have to be brutally mauled with pounders or mechanically chewed up by one of the newer electrically-driven devices if a new jet-tenderizing process invented by V. L. Tichy of Cleveland comes into general use. Also, it will be possible to use meat immediately after slaughtering, without the time-consuming processes of "hanging" or curing now necessary.

Mr. Tichy's process takes advantage of the long-known fact that a needle-fine jet or spray of liquid at very high pressure will penetrate flesh to a considerable depth. Workers around diesel engines are thus injured, sometimes, when a small leak develops in the high-pressure oil injector.

Exactly the same principle is used in the jet-tenderizing process. Spray-openings as small as a ten-thousand of an inch in diameter, with pressures as high as seven thousand pounds per square inch behind them, are used to drive droplets of tenderizing fluids into the meat. The fluids may be liquid fats, fiber-softening enzymes, mild acids or anything else that will accomplish the purpose. Small solid particles may also be shot through the jets, in liquid suspension. Meat can thus be salted and peppered in advance, if desired.

U. S. patent 2,418,914 has been granted on this invention.

Blighted Before Birth

➤ PLANTS can be blighted by the killer-chemical, 2,4-D, even before they are born. Dr. A. M. S. Pridham, Cornell University horticulturist, sprayed some plants of red kidney bean with 2,4-D while their pods were ripening. Seeds from these pods were planted, and produced a new generation of plants that had all the crippled appearance of plants that had been directly attacked with the chemical. Offspring of unsprayed plants kept as controls remained perfectly normal.

Appetizing bread can be made with sea water when necessary, by the omission of salt in the regular bread formula.

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